MUFFLER GUIDE THE VERY LATEST IN QUIET TECHNOLOGY

page 32

MODEL Airplane NEWS

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Ziroli's Dauntless—in kit form

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AirAGE

EDITORIAL

BY DEBRA SHARP

RC visionaries

At this year's Westchester Radio Aero Modelers (WRAM) Show in White Plains, NY, another one of modeling's legends was inducted into the AMA Hall of Fame. Nick Ziroli Sr. is a renowned model designer and builder who has published countless articles and plans. In the late '60s and '70s, Nick's popular Eindecker and Saulnier kits sold by the thousands and provided the momentum to make the annual Rhinebeck WW I Jamboree such a success. A Ziroli design is synonymous with flight success, and it's a sure bet that you'll see at least a few Ziroli designs on the flightline at any giant-scale or warbird event you attend. In fact, many models built from his plans have made it to the winners' circles at Top Gun, Scale Masters and other prestigious national competitions.

AMA president Dave Brown (right) presents Nick Ziroli Sr. with a plaque comemmorating his induction into the Hall of Fame.

Left: Norm Rosenstock, winner of the WRAM Howard McEntee Memorial award, shows off the hand-held transmitter he designed in the early '50s.

In addition to his scale RC accomplishments, Nick is credited with building the first remotely piloted vehicle (RPV) for the Israeli government, and he was contracted by the Navy to build research models of the F-14 Tomcat. We're proud to have him as a contributor to *Model Airplane News* (check out "Air Scoop" for his latest creation!).

Also at February's WRAM Show, Norm Rosenstock was inducted into the Vintage RC Society Hall of Fame and was presented with the Howard McEntee Memorial award, which the WRAM club has bestowed yearly since the mid-'70s. It's interesting to note that in July 1951, *Model Airplane News* published an article by Norm on converting a .049-powered free-flight model to RC. He wrote, "The idea ... occurred to me one day when I found my flying space becoming smaller and smaller .... Up until then, I had been flying 60-inch radio jobs which, by the old standards, were not large planes, but according to today's standards, not small ones either. It was obvious that if I could build an [.049-powered] RC ship, I might be able to fly it in the local baseball diamond or athletic field."

Ahead of his time, Norm saw the tremendous potential of having fun at small flying sites. Another of Norm's contributions to RC was a smaller, reliable transmitter that the pilot could hold while he hand-launched his model. Until then, modelers had used a large, ground-based unit that had a long cord and a switch at one end; pilots had to launch their models and then dash back to their transmitters. This innovation surely revolutionized RC!

Everyone at *Model Airplane News* sends warmest congratulations to both of these accomplished RC'ers.

MODEL Airplane NEWS

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p. 32

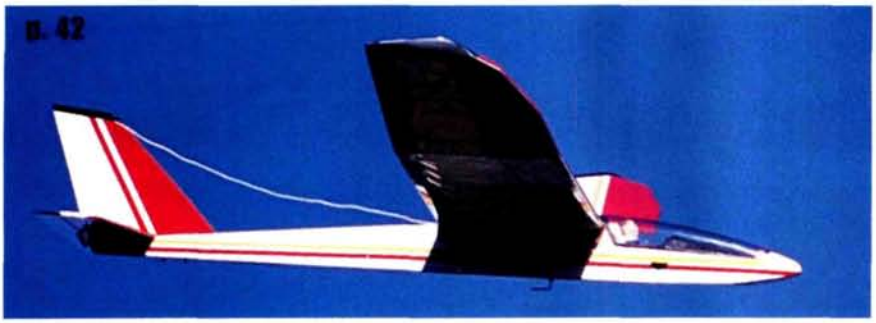
Features


p. 62


p. 38

Construction

Reviews


p. 42

ON THE COVER: main image—the SBD Dauntless as built by Bill Steffes. This Nick Ziroli design captures all of the majesty and muscle of the famed dive bomber (photo by Walter Sidas). Insets—have you ever dreamed of flying from the cockpit of your model? Virtual flight is now a reality in this month's "Final Approach," and Chris Chianelli looks at the giant-scale power-house Enya R1.55 4-stroke.

Columns


p. 146

Departments

AIRWAVES

Our readers write back

WRITE TO US! We welcome your comments and suggestions. Letters should be addressed to "Airwaves," *Model Airplane News*, 100 East Ridge, Ridgefield, CT 06877-4606 USA; email man@airage.com. Letters may be edited for clarity and brevity. We regret that, owing to the tremendous numbers of letters we receive, we can not respond to every one.

Congratulations

to the Horizon Hobby Distributors and *Model Airplane News* Grand Brands Sweepstakes winners:

1st prize—Saito FA-180 ($599.95 value)
Robert E. Zelensky, North Wilkesboro, NC

2nd prize—Hangar 9 CAP 232 ARF ($499.95 value)
Richard C. Lipford, Dawson Springs, KY

3rd prize—Hangar 9 PT-19 ARF ($499.95 value)
Alex Fuller, Claremore, OK

4th prize—JR/Hangar 9 Skypack ($449.95 value)
John West, Glenhaven, CA

5th prize—JR XP652 radio ($399.95 value)
Roger Armontrout, Mason, OH

6th prize—Zenoah G-23 ($399.95 value)
Don Moyer, Center City, MN

7th prize—Hangar 9 Easy 2 VRTF ($209.95 value)
Vernon Crews, French Lick, IN

8th prize—MDS 48 PRO ($119.95 value)
Phil Rentz, Santa Barbara, CA

RC MICROFLIGHT PHOTOS

The photos used to illustrate your *RC MicroFlight* newsletter and website articles are excellent! A question or two on how they were taken: camera—digital or film? Lighting? Pixels?

Thanks; I'm enjoying every educational issue! [email]

JOHN MUDROCK

Hi, John; thanks for the kind words.

The cameras used to produce our newsletter may be film-based or digital, and our contributors and staff photographers use any of the major brand names. We have published scanned color prints/slides, images scanned directly on flatbed scanners, e.g., tiny motors, and images taken with digital cameras.

The more pixels in your digital camera's charged couple device (CCD), the sharper the image at an acceptably large size. On the Web, the standard is 72 dots per inch (dpi) JPEG images—easy to produce with today's digital cameras and scanners. With regard to printed material, the trick is to start out with images that are at least 300dpi resolution at an image size that is acceptably large.

Our graphic artists and Web staff digitally enhance photos, whatever their source, using software tools such as Adobe Photoshop. The intricacies of digital imaging go beyond the space available here, and it is true that new, ever more powerful and less expensive digital cameras are coming onto the market all the time.

Thanks for your interest in RC MicroFlight*!* *TA*

PT-19 CONTINUED

I enjoyed Chris Chianelli's review of the Hangar 9 PT-19. No two ways about it, I had to buy one. OK; so I have it, and at first, I was going to put a Zenoah G-23 in it. Now, I'm set on a 4-stroke—ideally, a pumped one; either the O.S. 120III or the YS 120FZ. Are these engines powerful enough? I noticed everyone seems to be using the Saito 1.50, but Saito doesn't offer a pumped version, and I really prefer a pump for inverted engines. Do you find that the Saito runs well inverted, even without a pump? I guess the bottom line is: does a 1.20 have enough power to comfortably pull this plane around?

Also, could you give me some information on the Robart scale struts for this airplane? I found the Robart struts for the 25-percent PT-19 (Dynaflite), but these are too big. A part number—or a website that sells them—or any information would be great. (Robart doesn't list them on its website.) I thank you for a very well-put-together article (although the plane really sells itself!) and for any help you can provide.

DAVE DIXON
San Luis Obispo, CA

Any good 1.20 4-stroke has plenty of power for the PT-19. Horizon happens to market the model with a 1.50, and although it makes a nice combo, the plane doesn't really need this much power, especially for scale flight performance. When is the last time you saw a PT-19 with Sukhoi-like vertical performance?

Dave, 4-strokes really don't suffer from being inverted the way 2-strokes sometimes do. The 1.50 truly never missed a beat being inverted in the PT-19; it idled endlessly. I don't have a pump on this engine, nor does it seem to need one. I have, however, used Perry's oscillating pump on 4-strokes in aerobatic models where the high Gs can affect fuel draw on some engines. I've had very good results with this pump on 4-strokes. Remember: no matter which 4-stroke you decide on, always use an O.S. "F" plug; it's by far the best.

Robart's part number for the struts is PT19HA9. Have fun! *CC*

New products and people behind the scenes; my sources have been put on alert to get the scoop! In this column, you'll find new things that will at times cause consternation, and telepathic insults will probably be launched in my general direction! But who cares? It's you, the reader, who matters most! I spy for those who fly!

AIR SCOOP

BY CHRIS CHIANELLI

HANGAR 9 CLOTH-COVERED ARF *Cub*

Ever since Hangar 9's success with its IMAA-legal PT-19, everyone has been wondering what would come next. Well, here it is: a fabric-covered (not film), ¼-scale ARF Cub. I can't tell you that much about it right now, other than it's an all-wood model that's intended for 1.20 to 1.80 4-stroke or G23 ignition-size engines. Specs: wingspan—100 inches; area—1,350 square inches; length—65½ inches; flying weight—13 to 16 pounds.

Also new from Horizon is the J-line Quattro, which kicks off the new J-line series of radios manufactured by JR. The engineering and look are pure JR, but the big news is the price: the Quattro sells for $150. For that price, you get servo-reversing, four servos, rechargeable Ni-Cd batteries and proven JR electronics that are fully compatible with all JR radios. I'll keep you posted on other new J-line releases.

Horizon Hobby Distributors Inc., 4105 Fieldstone Rd., Champaign, IL 61822; (217) 355-9511; www.horizonhobby.com.

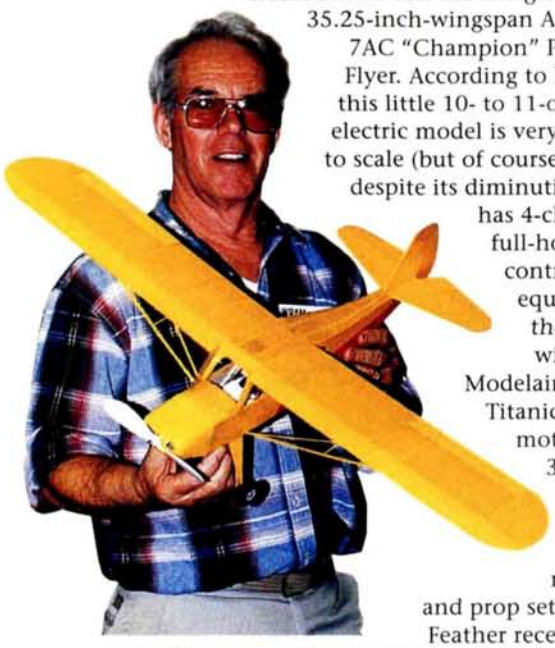
AN EZ RETURN

If you've been in the hobby for a long time, the name "EZ" probably isn't new to you. For those who've become involved more recently and might not know, it was OK Models in the mid-'80s that revolutionized ARF design and brought it to a new level with the introduction of its EZ line. Very briefly, these "kits" featured a patented triple-layer outer skin stretched over an inner wooden structure of ribs, spars, formers and stringers. Then and now, the line featured unparalleled graphic finishes, light flying weight and excellent parts fit. Moreover, many of the EZ designs were known for their excellent flight characteristics. It should come as no surprise that many modelers, including me, were quite disappointed when the line disappeared from the American market in the early '90s. Well, I'm very happy to report that EZ has returned to the States and is now available from Altech Marketing.

An Extra 330L and the CAP 3D (held by Akiko) are two of the initial offerings from Altech. Both models call for .40 to .50 2-stroke or .70 to .80 4-stroke power, and they feature factory-installed aileron hinges, factory-drilled motor-mounting locations, an extensive hardware package, a metal-backed spinner and metal motor mount. Extra specs: wingspan—50.39 inches; wing area—513 square inches; weight—86.5 to 90 ounces. CAP specs: wingspan—61.8 inches; wing area—857 inches; weight—102.3 to 105.9 ounces.

Altech Marketing, P.O. Box 7182, 80 Newfield Ave., Edison, NJ 08818; (732) 225-6144; www.modelrec.com.

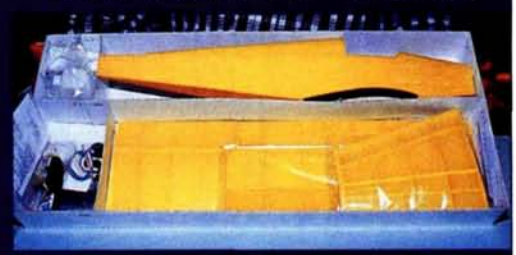
Ziroli "Champion" Park Flyer



Never one to be left out of the latest craze—or fun—the venerable Nick Ziroli has designed this 35.25-inch-wingspan Aeronca 7AC "Champion" Park Flyer. According to Nick, this little 10- to 11-ounce electric model is very close to scale (but of course!) and, despite its diminutive size, has 4-channel, full-house control. Nick equipped the model with Modelair-Tech's Titanic 280 motor with 3:1 reduction transmission and prop set, Hitec's Feather receiver and HS-50 servos and an FMA Direct speed control. Nick says, "The Champ has been an enjoyable change of pace from designing giant-scale models." We hope to see more of the same from Nick. You'll definitely be seeing Nick's Aeronca featured in an upcoming *Model Airplane News* construction article.!

Two Cute for Words

I knew that as a leader in the park flyer phenomenon, Hobby Lobby would have a "small-plane" surprise for us at the February WRAM Show in White Plains, NY—and here it is. The BeBe Jodel ARF, held by Amber to illustrate its diminutive size, is meticulously built up in all balsa and covered with Litespan. The POT2A motor/gear/prop-drive system is included. The model takes about five hours to build and flies with either 3 or 4 channels, with optional aileron control shown on the plan. Specs: wingspan—31.5 inches; wing area—163 square inches; flying weight—9 ounces; wing loading—8 ounces per square foot.



Hobby Lobby Intl., 5614 Franklin Pike Cir., Brentwood, TN 37027; (615) 373-1444; fax (615) 377-6948; www.hobby-lobby.com.

DYMOND TIGER MOTH— AN ARF CLASSIC

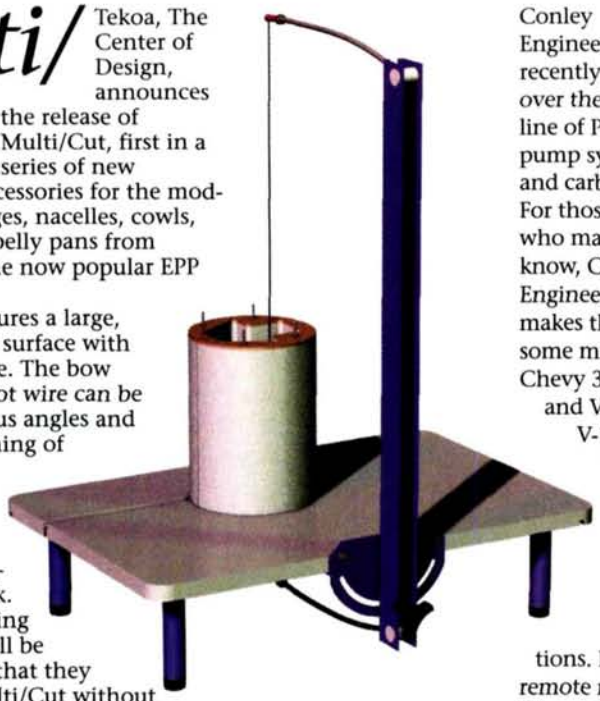
I found this all-new, Dymond Tiger Moth at the recent WRAM show and thought it looked very interesting, especially since this de Havilland classic is one of my all-time favorites. This all-wood model has features such as joined wing halves, totally built-up tail group (no heavy balsa slabs here), fiberglass cowl, installed servo extensions in the wings, prebent landing gear, steerable tailwheel, tank, wheels and bolt-on cabane and interplane struts. All this for a street price of $199, which I think is a super deal. Rumor has it a 1.20-size Moth is in the works. Specs: wingspan—51 inches; wing area—818 square inches; weight—5.5 pounds; power required—.40 to .46 2-stroke or .48 to .56 4-stroke.

Dymond Modelsport USA Ltd., 683 North Main St., Oshkosh, WI 54901; (920) 303-1100; fax (920) 303-2021.

COMPOUND SHAPES MADE SIMPLE

Multi/Cut

Tekoa, The Center of Design, announces the release of Multi/Cut, first in a series of new machines and accessories for the modeler to cut fuselages, nacelles, cowls, turtle decks and belly pans from Styrofoam and the now popular EPP foam.



Multi/Cut features a large, 16x24-inch work surface with a vertical hot wire. The bow supporting the hot wire can be adjusted to various angles and has a throat opening of 11x22 inches. Machined of aluminum, it has a blue-anodized finish—Tekoa's trademark.

Feather/Cut wing machine users will be pleased to know that they can purchase Multi/Cut without the hot wire bow and that they can use their existing 28-inch cutting bows.

Tekoa, The Center of Design, 49380 Skyharbor Way, Aguanga, CA 92536; (909) 763-0464; fax (909) 763-0109.

Complete Perry Smoke Systems

Conley Engineering has recently taken over the entire line of Perry pump systems and carburetors. For those of you who may not know, Conley Engineering makes those awesome miniature Chevy 327 V-8 and Viper V-10 engines.

Gary Conley is a perfectionist who is devoted to expanding and improving the Perry line. These complete smoke systems are his first two additions to the line. These systems are designed around either the Perry oscillating pump (above left), which works off the subtlest engine vibrations, or the regulating pump that operates off crankcase-pressure fluctuations. Both systems come with everything you'll need, including remote needle valve, remote smoke valve and check valve (not shown). The systems are available for either gasoline (gold-anodized parts) or glow fuel (blue-anodized parts). I'll keep you posted on Perry/Conley product updates.

Conley Precision Engines Inc., 825 Duane St., Glen Ellyn, IL 60137; (630) 858-3160.

NORTHEAST

Virus

According to the distributor, Northeast Sailplanes, "Of all the Speed 280-powered park flyers, the Virus has the lightest wing loading and slowest flying speed. It's great for tight maneuvering in smaller spaces. Every feature of the Virus was designed for fun and ease of flying." I saw the Virus at the WRAM Show, and the design certainly does look right.

It could be an excellent choice as a trainer because of its large wing area and turned-up wingtip design that gives excellent low-speed handling characteristics. The Virus incorporates dual carbon-fiber tail booms and flexible landing gear to stand up to those "less than perfect" landings we all make from time to time.

You will need only a few hours to finish the mostly prefabricated Virus. All the components come built and covered with light Solarfilm. A MiG 280 motor with gearbox and prop are included, as are all hardware and landing gear.

Northeast Sailplane Products, 140 Kirby Ln., Williston, VT 05495; (802) 658-9482; www.nesail.com.

PILOT PROJECTS

A look at what our readers are doing

CANAL CRUISER

It took Rafael Cano 2½ years to finish this Jet Hangar Hobbies A-4 Skyhawk. Working out of his home in Balboa, Panama, "Pepo" (as he is also known) installed scale landing gear, operating flaps, an arresting hook, speed brakes, landing lights, positioning lights and anti-collision lights in his model. The armament is interchangeable, so he can mount bombs or rockets! With the Skyhawk, he won Best Workmanship and Best Static Display at the Costa Rica Tropical Fun Fly.

TEL AVIV AVIATOR

Ron Tossman of Tel Aviv, Israel, shares this photo of his 6-month-long project, a Great Planes Patriot. The MVVS .49-powered plane is "so over-powered it can take off straight up." The 15-year-old modeler equipped the Patriot with retracts and covered the plane with a color scheme designed by his father. This picture was taken just before the plane's test flight, and Ron reports that It flies very well.

MOSHER'S MITSUBISHI

Vance Mosher's AGM 3-22 Zero must turn heads at the flying fields of Vancouver, WA. It has an 86-inch wingspan and is powered by a SuperTigre 3000 engine. Vance modified a Berth Baker kit by adding Robart 615-6 retracts and a homemade spinner. Vance says that the 20x10 Master Airscrew prop gives this warbird a realistic sound, too.

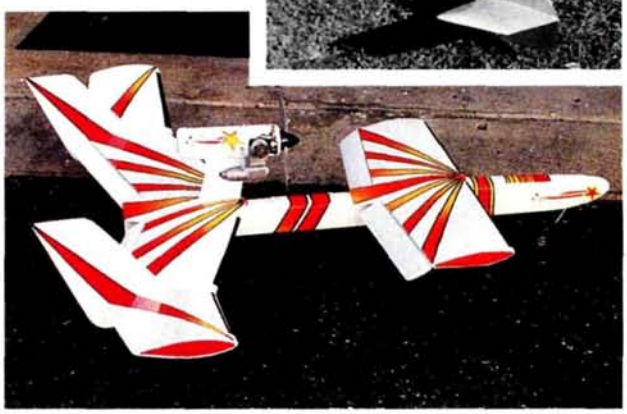
SEND IN YOUR SNAPSHOTS. ***Model Airplane News*** **is your magazine and, as always, we encourage reader participation. In "Pilot Projects," we feature pictures from you—our readers. Both color slides and color prints are acceptable. We receive so many photographs that we are unable to return them.**

All photos used in this section will be eligible for a grand prize of $500, to be awarded at the end of the year. The winner will be chosen from all entries published, so get a photo or two, plus a brief description, and send them in!

Send those pictures to: Pilot Projects, *Model Airplane News*, 100 East Ridge, Ridgefield, CT 06877-4606 USA.

THE CANARD MAN

Bill Fileccia of Gaylord, MI, has been designing models since the 1950s. The black-and-white photo is one of his original works and, as you can see, he's still coming up with original creations. This canard design is one of his latest works. The balsa and foam plane is powered by a .25 Thunder Tiger engine and uses three channels.



EMPIRE STATE AEROBAT

This Staudacher GS-300 is from GiantScalePlanes.com and was built by Don Corbett of Oneonta, NY. He modeled his Lap Map after Mile Goulian's craft, using MonoKote and GiantScalePlanes.com graphics to complete the design. This aerobat has a 90-inch wingspan and is powered by a G-62 Zenoah engine.

SMALL BEGINNINGS

Stefano Salani of Miami, FL, has always liked the unique look of the Cessna 336/337 Skymaster, so he decided to model one. He took a 1/12-scale plastic kit and used it to draw a 1/6-scale plan from which to scratch-build the RC craft. He spent two years on it, but with perseverance, Stefano finished this 11-pound, dual GS .42-powered plane. Even though flaps aren't necessary, he thinks that adding them could be his next modification.

LUFTWAFFE ACE

Jim Lynch of Tucson's IMAA chapter sent us this photo of Dave Inskeep and his Messerschmitt Bf-109 G6. Built from Meister Scale plans, this Quadra 75-powered model has a 100-inch wingspan and weighs 29 pounds. The photo was taken at the Tucson Radio Control Club's flying field, where the annual Wings Over the Desert IMAA fly-in is hosted each April.

PIPE DREAM

Craig and Mark Hoisington of Rio Rancho, NM, have been flying models for more than 20 years. What better way could there be for Craig to celebrate his brother's 40th birthday, Christmas *and* the first anniversary of Mark's business than with a new plane? This Sig Ultimate Fun-Fly is powered by an ASP .45 and is trimmed in white and blue MonoKote. The "present" project weighs just under 5 pounds and serves as an excellent advertising billboard as well.

LEAVE IT TO BEAVER

Bob van't Riet of Los Osos, CA, built this beautifully detailed 1/6-scale de Havilland Beaver from a slightly modified Ikon N'West kit. The 17-pound model is equipped with an O.S. 1.20 III engine and has a dope and *Polyspan finish topped with Stits Poly-Tone* paint. Bob installed JR radio gear, including seven servos to operate the flight controls. An eighth servo is programmed to move the tailwheel half of the rudder deflection.

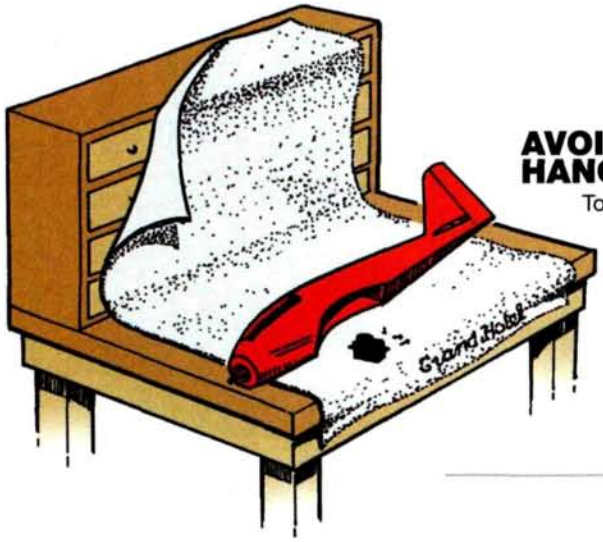
A HAPPY CAMPER

This shot of a 1/4-scale Pietenpol Aircamper was submitted by Warren Weaver of Duncan, OK. The 80-inch-span plane was constructed from a House of Balsa kit and is finished in the original cream and maroon colors of the full-scale plane he modeled it after. Warren powers this "antique" beauty with a 4-stroke .91 Magnum engine and notes that it flies realistically.

HINTS & KINKS

BY JIM NEWMAN

SEND IN YOUR IDEAS. Model Airplane News will give a free one-year subscription (or one-year renewal, if you already subscribe) for each idea used in "Hints & Kinks." Send a rough sketch to Jim Newman c/o Model Airplane News, 100 East Ridge, Ridgefield, CT 06877-4606 USA. BE SURE YOUR NAME AND ADDRESS ARE CLEARLY PRINTED ON EACH SKETCH, PHOTO AND NOTE YOU SUBMIT. Because of the number of ideas we receive, we can't acknowledge each one, nor can we return unused material.



AVOID HANGAR RASH

To prevent hangar rash during final assembly, cover your workbench with an old towel or rug. Not only does this help you avoid making nasty dents as you move your model around, but it also catches the screws you drop.

Glenn Bolick, Mechanicsville, VA

POXY POKER

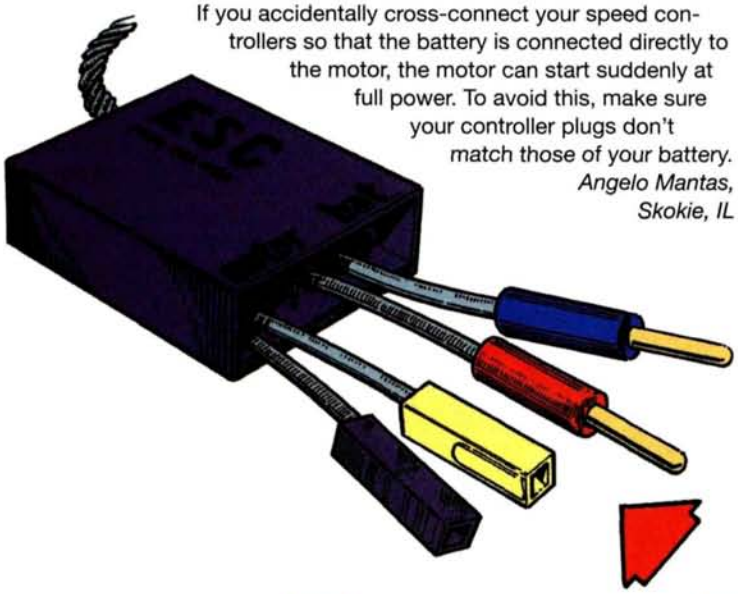
Cut a business card into strips, then use them to poke epoxy into the hinge slots. The light card gives an excellent "feel" of how well the slot is coated with glue. To keep glue out of the rotating hinge, coat it with petroleum jelly, then warm it with a hair dryer to melt the grease into it. Secure the hinges with toothpicks after you have glued them in.

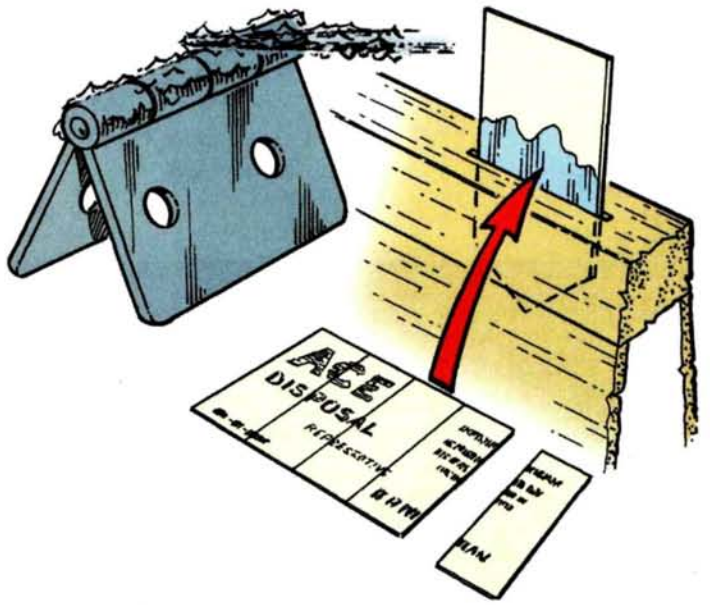
Marvin McKelvy, Centralia, MO

PROPER PLUGGING

If you accidentally cross-connect your speed controllers so that the battery is connected directly to the motor, the motor can start suddenly at full power. To avoid this, make sure your controller plugs don't match those of your battery.

Angelo Mantas, Skokie, IL

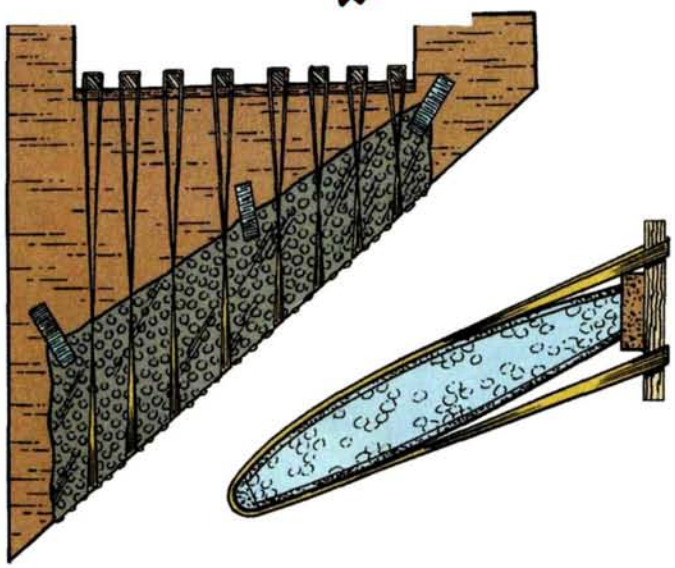




DELTA DILEMMA

Delta wings and other sharply swept wings can present a problem when you attempt to glue on the leading- and trailing-edge sheeting. A strip of bubble wrap taped to the leading edge will prevent the rubber bands from "sliding" along the wing's swept angle. Short sticks provide an anchor for the rubber bands that hold the trailing edge in place while the glue sets.

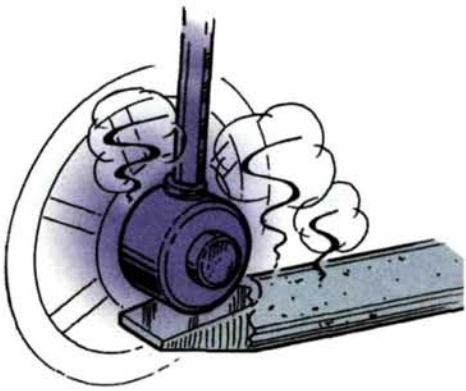
Robert Kenton, Reno, NV

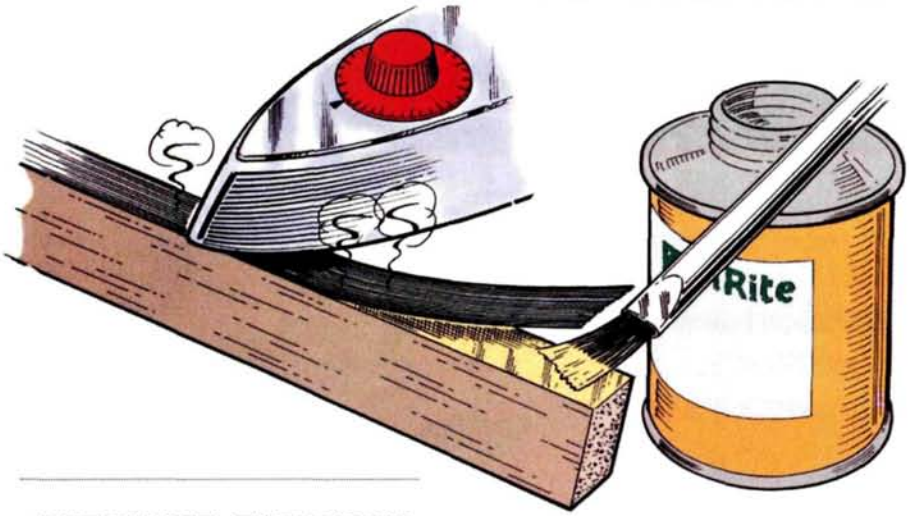


HOT TIP

To remove wheel-collar setscrews that have been secured with thread-lock, hold a hot soldering iron against the collar as you twist the Allen wrench. The heat softens the thread-lock so you can free the setscrew.

Bill Griffith, Bakersfield, CA





THE CA BLUES

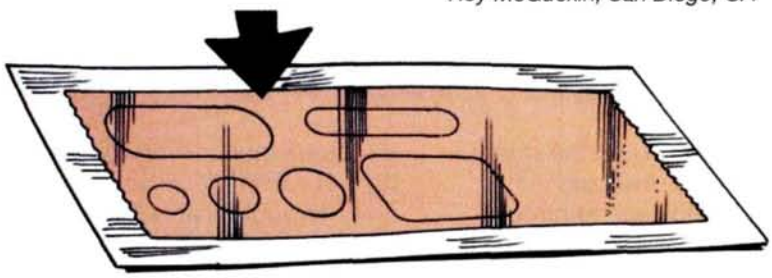
Like many modelers, Dennis cannot tolerate CA fumes, so he developed a different technique to attach carbon fiber to wing spars. He paints the spar with Balsarite, applies the carbon-fiber strip, then activates the adhesive with a hot iron. When the carbon is firmly bonded, he brushes on a coat or two of epoxy. Best of all, his only cleanup is to toss away the disposable brush.

Dennis McFarlane, Highland, IN

PATCH ME THROUGH

If your covering is punctured, use 2-inch-wide (50mm) packing tape for temporary field repairs. Apply some strips to pieces of wax paper—if you wish, precut a few patches with a sharp modeling blade—then place them in the bottom of your flight box just in case.

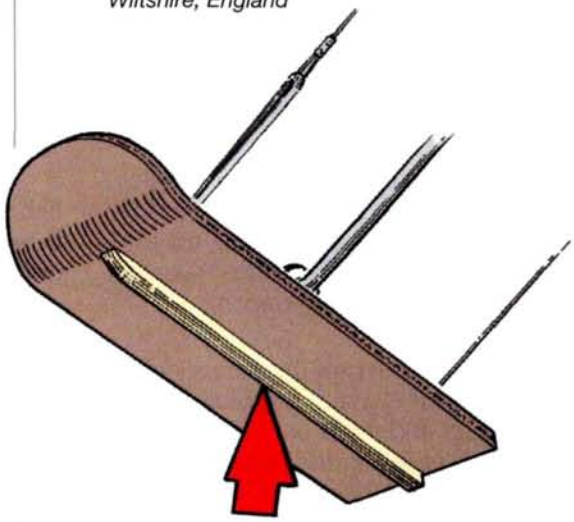
Roy McGuckin, San Diego, CA

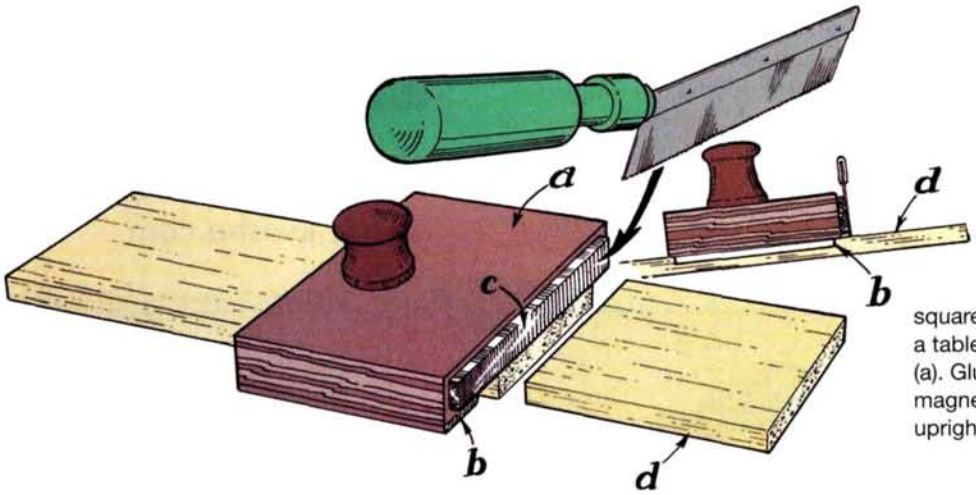


SKI STABILITY

Keep your skis pointing down the runway by gluing a piece of ⅛-inch-square (3mm) spruce to the ski bottom. This keeps your model on its heading instead of allowing it to skid sideways with its nose pointing into the crosswind.

Bob Robert, Durrington, Wiltshire, England





SAW AUTOPILOT

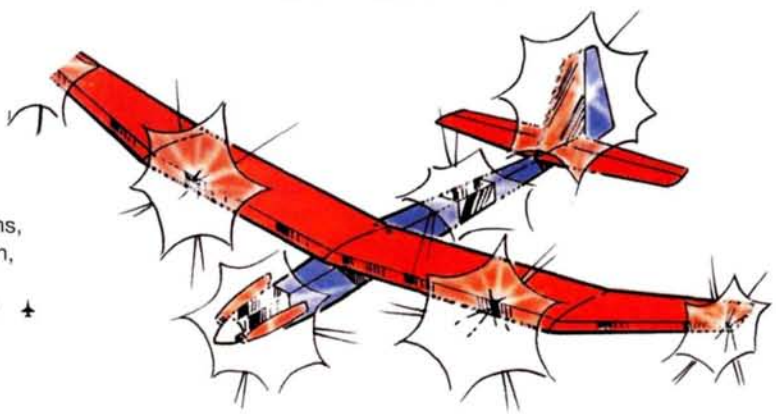
This smart device keeps your model saw square and upright while you cut thick sheet wood. Use a table saw to cut the ½-inch-thick (13mm) wood block (a). Glue a guide strip (b) to the bottom, and glue a strip magnet to one edge (c). The magnet holds the saw upright yet allows it to be slid back and forth (d).

Ed Braddy, Evergreen Park, IL

NON-ELECTRIC FLASHER

Because gliders fly far and high, they're sometimes difficult to see. Apply "chrome" Mylar tape to the wing and fuselage. As the craft turns, the tape will flash brightly in the sun, and you'll be able keep track of it.

Mark Brock, Newton, KS



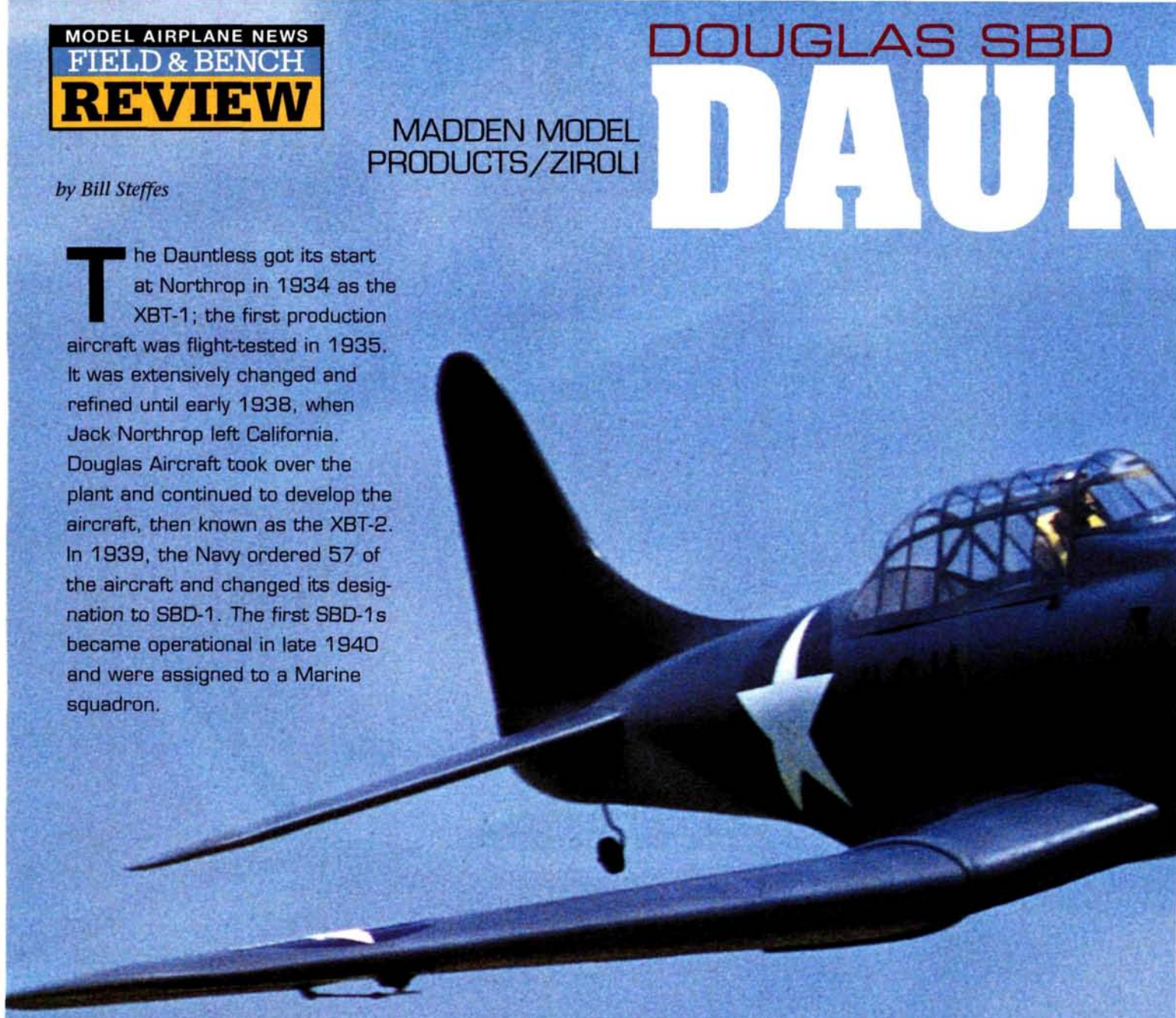
MODEL AIRPLANE NEWS
FIELD & BENCH
REVIEW

DOUGLAS SBD DAUN

MADDEN MODEL PRODUCTS/ZIROLI

by Bill Steffes

The Dauntless got its start at Northrop in 1934 as the XBT-1; the first production aircraft was flight-tested in 1935. It was extensively changed and refined until early 1938, when Jack Northrop left California. Douglas Aircraft took over the plant and continued to develop the aircraft, then known as the XBT-2. In 1939, the Navy ordered 57 of the aircraft and changed its designation to SBD-1. The first SBD-1s became operational in late 1940 and were assigned to a Marine squadron.



An impressive, 1/5-scale WW II dive bomber

Further refinements of the aircraft led to versions SBD-2 through SBD-6, as well as a land-based variant known as the Douglas A-24 Banshee. The Navy designation SBD stood for "Scout-Bomber, Douglas," denoting both the aircraft type and its builder. Throughout its WW II service, however, the Dauntless was affectionately referred to as "Slow But Deadly."

THE MODEL

I had flown a Ziroli AT6 for several years and wanted something new, so I decided to build the Ziroli Dauntless SBD-3. I ordered the plan, canopy, cowl and wing-tube assembly from Nick Ziroli Plans*. Next, I called Gary Madden of Madden Model Products* and ordered a kit. When it arrived, I opened the box and examined the parts. It was obviously a deluxe kit because all the wood was of exceptional quality, and the bulkheads and ribs were machine-cut and sanded. The balsa sheeting had been straight-line ripped to ensure good butt joining for the wing skins, and the stick wood had been machine-sanded on all four sides. Many of the parts were bagged and labeled, and Gary also provided a complete parts list.

TAIL GROUP

Construction of the horizontal stab is pretty straightforward; since it will be needed later in the fuselage construction, I like to build it first. If you choose to build scale hinging instead of standard model hinging, Nick's plan shows you how. If you choose the scale method, follow the scale rib locations shown on the plan, and use parts EH-1 and 2. The plan shows two separate horn plates for the elevators. Another option for a more scale-like appearance is to make a wire joiner that has a center horn to connect the elevator halves; this eliminates exposed elevator horns. The fin and rudder are also shown in detail; it's quite easy to build them. After the tail group had been completed, I finished the stab with 1-ounce fiberglass cloth and Zap* finishing resin.

WING CENTER SECTION

Before you build the center section, you must decide whether you want retractable or fixed landing gear. A diagram is shown in the plan for bending music wire for a set of fixed landing gear. Robart Mfg.* offers retractable landing gear for the SBD; these can be purchased from either Nick Ziroli Plans or Robart.

Gather all the wing parts labeled for the center section and begin construction by pinning the bottom main spar and the rib shim over the plan. Place WS-1 in front of the spar, and slide ribs W-1 through W-6 as

TLESS

well as W-4A and W-6A into place. Make sure that the spar and ribs are in their proper places, and check that the rib tips rest on the rib shim without forcing them down. If any have lifted, sand the rib spar slot to relieve the wood so it can rest properly on the shim (don't do any gluing yet). Put the upper main spar in place but don't force it into the rib slots; then check the rib placement on the shim again. Put the top and bottom basswood spars in place and slide in WS-2. When the ribs are in their correct positions, use some thin Zap to lock everything into place.

Fit the sub leading edge to the front of the ribs and glue it into place. Then use some Zap CA Plus to glue into place the two top and bottom rear spars. With Zap 30-minute epoxy, glue WMP-1, WMP-2, the bellcrank mounts and the retract mounting blocks into place. Fit the aluminum wing-tube sleeve into ribs W-4, W-5 and W-6, making certain it's straight; an easy way to do this is to place the tube in the sleeve and use a 90-degree triangle to check the top, front and back of the tube relative to W-6. If the fit is good, go ahead and use Zap 30-minute epoxy to glue it into place.

The next step is to assemble the precut flap (the one with a zillion holes in it) and ribs, following the plan for guidance. After the flap has been assembled, you will notice that the flap ribs are oversize; this is so they can be sanded to fit. I used Du-Bro* hinges for the flap setup, and I cut slots in the spar to accept the hinges before I sheeted the wing. Fit the flap into place and follow the plan section at W-4 for the linkage setup. This completes the wing frameup; now, the center section can be sheeted. (You may fit the retracts into place now or after the wing has been sheeted.)

I like to sheet the bottom of the wing first and then place it back down over the plan and rib shim to hold it straight while I sheet the top. After the sheeting has been completed, add the leading edge and sand it to shape. Also sand the entire center section to prepare it for fiberglassing. I like to glass as I go so I don't have to do it all at once.

SPECIFICATIONS

Model: Douglas SBD-3 Dauntless

Manufacturer: Madden Models (plans from Nick Ziroli Plans)

Type: 1/5 scale

Wingspan: 100 in.

Wing area: 1,750 sq. in.

Weight: 30 lb.

Wing loading: 39.5 oz./sq. ft.

Length: 76 in.

Radio req'd: 8-channel (rudder, elevator, aileron, throttle, flaps, retracts, bomb drop and speed brakes)

Engine: 3.7 to 4.4ci

Engine used: Zenoah G-62

Prop used: Zinger 22x10

Prices: $46 (plan), $48 (cowl), $24 (canopy), $395 (kit)

Comments: as with any giant-scale warbird, the Ziroli-designed SBD Dauntless is not intended for the beginning builder or flier. The model is an excellent flyer.

Hits
- Excellent wood.
- Very good parts fit.
- Great flight characteristics.
- Well-drawn plan.

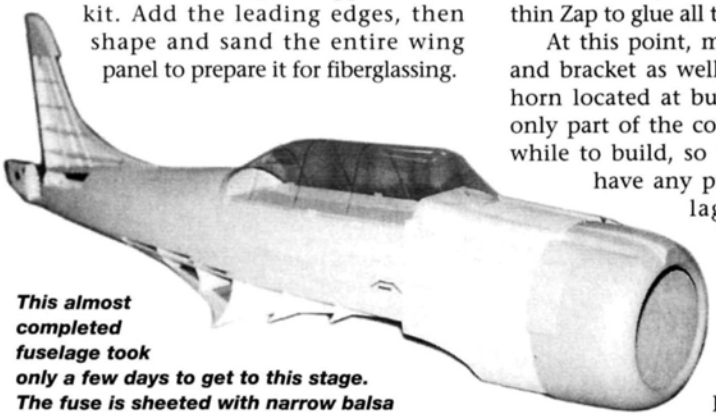
Misses
- A fiberglass cowl for the SBD-5 version is not available.

OUTER WING PANELS

The wing panels are framed in the same way as the center section. When you glue in rib W-7, take some small pieces of balsa and temporarily tack-glue them around the edge of the center section W-6 rib. Place the wing-joiner tube in the sleeve, and slide W-7 and W-7A onto the tube and against the temporary pieces. Slide the wing panel onto the tube, and use the two WA-1 parts to set the dihedral. With the panel in the correct position, glue the spars, W-9A and the wing-tube sleeve into place to lock the panel at the correct dihedral angle.

Remove the wing panel and the temporary balsa pieces from the center section. Slide the panel back onto the tube while aligning W-6 with W-7, and drill the two 3/8-inch alignment dowel holes through W-6 and W-7. Glue the dowels and support blocks into place as shown on the plan. Remove the wing panel and start sheeting the bottom surface. Be careful not to twist it out of shape.

Aft of the rear spar, cut off ribs W-8 through W-12. If you plan to use the dive brakes, do not cut off ribs W-7 and W-13. Place the wing panel back over the plan, and use shims to lock it into place to get the proper amount of tip washout. With the washout set, finish sheeting the wing. The plan shows Du-Bro hinges; if you use them, it helps to cut the hinge slots in the trailing edge of the wing and the leading edge of the aileron and dive brakes before you do any sheeting. Separate the aileron from the wing, and finish it as shown on the plan. Build the flap and dive brake as shown using the cut and drilled parts supplied in the kit. Add the leading edges, then shape and sand the entire wing panel to prepare it for fiberglassing.

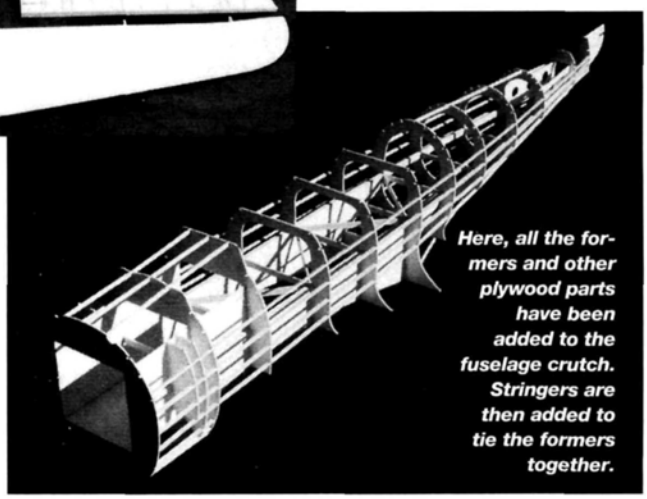


This almost completed fuselage took only a few days to get to this stage. The fuse is sheeted with narrow balsa strips (planks) and then sanded until smooth.

FUSELAGE

As with all Ziroli designs, construction begins by building a crutch over the plan. Note that FWS-1 is built as part of the crutch and is shown on the plan. After the crutch has been built, remove it from the plan and place the bulkheads at their proper locations. I like to start by sliding the middle bulkhead (F-6) into place, and then I work outward toward both ends. Don't glue the bulkheads into place yet, as you will have to support the crutch up from the table so the bulkheads don't touch the work surface. To support the crutch, I used three pieces of a common 2x10 construction board. Place one piece near the firewall, one somewhere near the middle and one at the tail of the crutch. Using a 90-degree triangle, Zap the bulkheads into place and make sure they are vertical. After that has been completed, Zap part SS-1 into place and begin installing the fuselage stringers, making sure that the crutch remains flat against the support pieces. Use thin Zap to glue all the stringers into place.

Build the horizontal stab and elevators first, as they are needed to complete the fuselage construction.



Here, all the formers and other plywood parts have been added to the fuselage crutch. Stringers are then added to tie the formers together.

At this point, make the tailwheel wire and bracket as well as the rudder control horn located at bulkhead 14. This is the only part of the construction that takes a while to build, so do it right; you won't have any problems after the fuselage has been sheeted. Partially sheet the upper fuselage half. I find that strip planking works the best since the fuselage tapers quite a bit. Proceed slowly, and check the fuselage straightness often so you don't build a twist into it. Remove the fuselage from the supports, and put in the pushrods and rod supports. Place the remainder of the stringers in the bottom halves of the bulkheads, and glue them into place. Also Zap WS-1 into place; it forms the wing saddle. You'll need the wing center section to get the wing-saddle pieces installed properly.

Now is the time to decide whether you want an SBD-3, -5, or an A-24 variant of the Dauntless. The plan is drawn for an SBD-3, but with a couple of slight revisions, you can modify the plane to produce the other versions.

Finish planking the fuselage, and sand it to shape. You might want to do as I did and make the ventilation slot on the side of the fuselage functional so the engine can be properly cooled. The plan doesn't show the opening in the firewall, but it is easy to figure out. The engine cowl does have cooling flaps at the top, but I don't think they will provide enough airflow over the engine head. The vent-slot modification is easy to do.

DETAILING AND FINISHING

Use 1-ounce fiberglass cloth and Zap finishing resin to cover the model where needed. The elevator, rudder and ailerons will be covered with heat-shrink fabric covering, so don't glass these parts. The flaps and dive brakes don't need to be covered with glass cloth; a coat of resin will be enough. After the finishing resin has been sanded, prime the plane and

DIVING DAUNTLESS IN THE WINNERS' CIRCLE

Another version of the Ziroli-designed SBD Dauntless scored very well at the 1999 Phoenix, AZ, Scale Masters Competition; it placed first in the Expert class. Built and flown by well-known scale competitor Greg Hahn, the 1/5-scale, Zenoah G-62-powered model also brought home the Best Military award.

Greg is a very talented RC pilot, and he earned a top-three average flight score of 92.83. Perhaps his most impressive maneuver is a very prototypical, 90-degree, straight-down diving bomb run while employing functional divebrakes. The Dauntless looks very realistic as it releases its bomb, and—as on the full-size aircraft— the divebrakes prevent excess airspeed from building up.

Featuring a fiberglass-cloth-and-resin finish, the beautifully detailed and weathered model is painted with automotive acrylic enamel. Robart retracts, Glennis* wheels and a JR* radio complete Greg's Scale Masters-winning package.

sand the model smooth to prepare it for final painting.

If you want to add panel lines, refer to a scale 3-view drawing to draw the lines on your model. I use 1/32-inch drafting tape and apply it directly over the drawn lines. Spray a couple of coats of primer over the tape, let it dry and then lightly wet-sand with 600-grit sandpaper. Remove the tape after sanding to leave a slight groove in the primer to form the panel lines.

To achieve raised-rivet detail, I use Zap canopy glue applied with a hypodermic needle. Once all the surface details have been done, the model is ready to be painted. I painted my Dauntless with automotive lacquer.

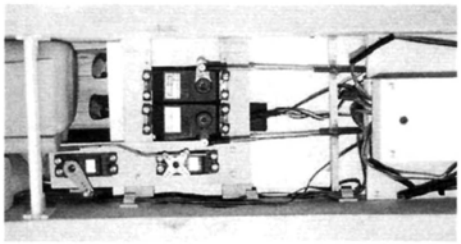
The Dauntless cockpit is a great subject to detail; I used a Dynamic Balsa and Hobby Supply* cockpit kit. These are vacuum-formed plastic kits that include the instrument panel, pilot seat, roll-over cage and all the other associated parts. A nicely detailed gunner kit is also available but does take some time to install. The effort, however, is well worth it.

The center bomb-release mechanism is a trademark part of any scale Dauntless model and is available from Robart. If you fly your model in scale competition, it's always a nice mechanical option to be able to drop a bomb. A scale bomb kit is available from Frank Tiano Enterprises*.

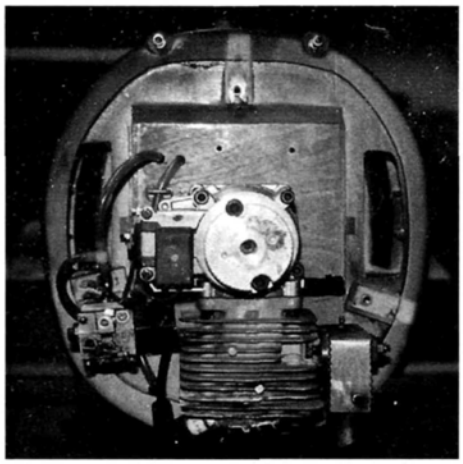
I used a Zenoah* G-62 with a Zinger 22x10 prop to power my Dauntless; it has more than enough engine to fly the plane. The radio I used is the Airtronics* Stylus 8-channel, which I prefer for flying scale warbirds because it has great flexibility in assigning the channels to different switches to fit the pilot's needs.

Addresses are listed alphabetically in the Index of Manufacturers on page 142.

Here, the landing gear has been bolted into place in the wing. Note the wing-tube socket behind the wheel well.



A typical radio installation. There is plenty of room in the fuselage.



My Zenoah G-62 attached to the firewall. Notice vent holes on either side of the firewall.

The prototype of Nick's Dauntless was designed to be powered by the impressive Robart radial engine. It turns a homemade, 25x12 3-blade prop.

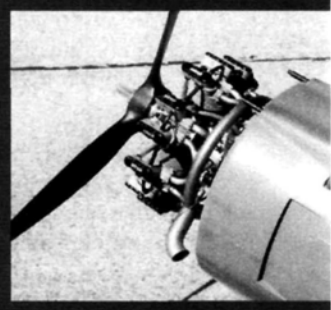
MADE FOR A ROBART RADIAL

When Nick Ziroli started designing his SBD Dauntless, he planned from the beginning to power his model with the 7-cylinder radial engine offered by Robart Mfg. The Robart R780 is approximately 1/5 scale and is based on the full-size Jacobs 225hp engine that powered so many civilian and military aircraft of the 1930s, '40s and '50s.

The R780 is a 4-stroke engine that has a displacement of 7.8ci (128cc) and produces approximately 10 to 12hp. The cylinders are machined of aluminum bar stock; the heads are investment-cast and have a hemispherical combustion chamber.

The engine is available in either glow or spark-ignition versions. The engine turns a very large 26x16 prop and has an rpm range of 1,600 to 6,500. Each cylinder has its own exhaust pipe, and an optional exhaust collector ring is available. A welded steel tube engine mount with rubber soft-mount points comes with the engine.

The sight and sound of a powerful multi-cylinder radial engine is indeed impressive. The marriage of the R780 and the Ziroli SBD Dauntless is a match that's hard to beat. In fact, you could say they were made for each other.



The radial engine has seven cylinders, and all the exhaust pipes are connected to a steel collector-ring exhaust system. The sound is awesome!

FLIGHT PERFORMANCE

• TAKEOFF AND LANDING

For takeoff, I advanced the throttle slowly to full power and held a little right rudder so the plane would track straight down the runway. With a little up-elevator, the model climbed out nicely as I retracted the landing gear. The G-62 provided plenty of power, and I flew the plane around the field a couple of times before I set up for some mock landings. By keeping the plane at a safe altitude and dropping the flaps, I could see what the plane could do. I was quite surprised to find that the flaps really slowed down the plane (more than I had anticipated). Knowing this, I approached for landing with some power on so the plane wouldn't slow down too much and stall in.

On the first landing, I came around and lined up the plane with the runway, dropped the flaps and came back to about 1/4 throttle. At that setting, the plane had a good sink rate right down to the runway where some additional elevator was needed to flare in for a great wheel landing. At the time, I felt that it took a little more up-elevator to flare than it should have.

On the second flight, I did some rolls and loops, and this was when I found out why the plane needed so much elevator during landing. I was running out of elevator on the back side of loops, so the first thing I checked was the amount of elevator throw. Control throw seemed correct so I removed 16 ounces of nose weight from the plane and flew it again. This made everything feel much better, and because the model is not nose heavy, less elevator is needed. Removing the nose weight moves the balance point 1 inch farther aft than is shown on the plan.

• HIGH- AND LOW-SPEED PERFORMANCE

What can I say? This plane has no bad habits at all. It is not an unlimited aerobatic flyer; it is a warbird and should be flown as such. Keep all your maneuvers smooth, and don't bang the sticks around when you fly.

Aftermarket Muffle

Using a muffler isn't just a good idea; it's a requirement. The ones that come with our engines, however, might not fit all of our modeling requirements. If you are into scale models, one of your challenges is to fit the muffler inside the cowl. If your club has engine-noise restrictions, you need a muffler that can make your engine "club legal" while still allowing it to deliver maximum performance. But where do you find a good muffler?

We have surveyed the most popular aftermarket muffler manufacturers and distributors for this guide. From standard sport mufflers to in-cowl upright and inverted installations to the ever popular side-mounted Pitts-style mufflers, you'll find a source that will meet your noise-reduction requirements. Are you looking for "smoke" mufflers? Many of the companies listed here offer their products with smoke fittings and coils. For those looking for performance increases, tuned pipes are also listed and, for these, there are add-on after-mufflers to take the "nitro bark" out of their increased engine performance.

We couldn't possibly list every muffler made, but we have included company names, addresses, phone numbers and basic price ranges to make your search just that much easier. If you value your flying field, a good muffler is a must.

Aerrow Inc.-Quadra

P.O. Box 183
Perth, Ontario, K7H 3E3 Canada
(613) 264-0010
fax (613) 264-8441

■ Tuned mufflers (quiet and ultra quiet) and tuned-pipe systems for Quadra engines. $175 - $245.

Air Hobbies

1621 Liberty Ridge Rd.
Concord, NC 28025
(704) 788-9042
www.aero-sports.com/airhobbies
airhobbies@zeronet.net

■ Combined engine mount/muffler—$90 - $140 (small), $120 - $160 (larger); single and twin gas engines: call for prices.

B&B Specialties

14234 Cleveland Rd.
Granger, IN 46530
(219) 277-0499

■ Machined/cast-aluminum mufflers for gas engines; smoke available—$25.95 - 36.95; big twin opposed w/smoke—$90.95.

Guide

by Gerry Yarrish

Loud is out!

C.B. Tatone Inc.

21658 Cloud Way
Hayward, CA
94545
(510) 783-4868
fax (510) 783-3283

■ Cast-aluminum strap-on mufflers/in-cowl—$14.84 - $19.68; Pitts style—$20.48 - $27.39; gas engines—$27.93.

Cactus Aviation

10380 East Heritage
Tucson, AZ 85730
phone/fax (520) 721-0087
www.pclink.com/cactus

■ Mufflers for 3W gas engines, Johnson Pitts style—$95; 3W quiet canister-style w/headers and couplers—$245 (small series/pair), $315 (L series), $365 (LL series).

Davis Model Products

P.O. Box 141
Milford, CT O6460
(203) 877-1670
fax (203) 876-2731

■ SoundMaster tuned mufflers and pipes; strap-on with engine adapter plate. Several configurations available, including Pitts style and sport—$39.95 - $65; giant-scale gas up to 6ci—$150.

Don Harris Model Products

23668 Shadow Dr.
Auburn, CA 95603
(530) 269-1164

■ Smoke mufflers and pump systems; gas, glow, 2- and 4-strokes (Smoke and Sound)—$75 - $95; big twin 4-stroke—$250; big twin gas—$200.

Internally preheat smoke fluid in this chamber.

Fox Mfg. Co.
5305 Towson Ave.
Fort Smith, AR 72901
(501) 646-1656
fax (501) 646-1757
■ 2-stroke glow, angled mufflers and muffler extensions—$17.95 - $28.95; Fox 4.8 twin gas—$145.

Gerard Enterprises Inc.
13435 Rosewell Dr.
Brookfield, WI 53005
(414) 784-4510
fax (414) 784-4520
■ Bisson custom mufflers and headers for 2-stroke glow and gas; smoke available; aluminum satin finish; sport and Pitts styles available; 2 .9 - .80—$28 - $33; Moki 1.20 - 2.10—$44 - $89; gas engines—$38 - $135.

Muffler Operation *by Dave Gierke*

A successful muffler must reduce pressure fluctuations in the engine's exhaust gas—acoustically. Discounting sound-canceling systems, two primary muffler types accomplish this: the expansion chamber and the resonator.

EXPANSION CHAMBERS

The simplest expansion chamber is the Helmholz chamber (Figure 1) that, if properly designed, works remarkably well despite its obvious simplicity. A sophisticated variant is shown in Figure 2 and has proven to be a very effective solution. Single chambers, double chambers, double chambers with external connecting tubes (Figure 3), and double chambers with internal connecting baffles (Figure 4) were all designed in accordance with the "plane-wave theory." This theory assumes that sound is transmitted through a tube in the form of a one-dimensional plane wave. Wherever the tubes encounter sectional area changes, part of the sound is transmitted along the tube, and part is reflected toward its source. The reflected component represents a reduction in sound. Expansion-chamber mufflers reduce noise by taking advantage of these reflections. The theory also says that below a certain frequency (known as the "cut-off frequency") expansion-chamber mufflers are relatively ineffective. To be effective, these chambers must be designed for an rpm band (range) that extends to the engine's operational upper limit.

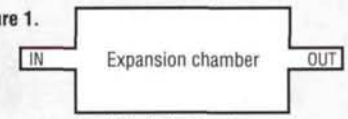
RESONATORS

Mufflers of the single-chamber-resonator type (Figure 5) consist of a resonant chamber that is connected in parallel with the exhaust pipe by one or more tubes or orifices. Resonance refers to a reinforcement of vibrating sound in a tube caused by waves from another chamber vibrating at nearly the same rate. In certain frequency ranges, as determined by the engine's operating speed, the impedance (for our purpose, resistance) at the connector is much lower than the tailpipe's impedance. The resonant chamber then acts as a short circuit that reflects most of the incident sound toward the source (as with the expansion chamber). Therefore, the amount of sound energy that is permitted to go beyond the muffler into the tailpipe is reduced. In multi-chamber resonators (Figure 6), engineers use equations to determine orifice impedances while simultaneously incorporating the plane-wave theory to determine the action of the central tube. Multiple resonators, like multiple expansion chambers, have a cutoff frequency.

Of course, there are combinations of expansion and resonant chambers that offer the potential for improved muffler performance by combining the attributes of both types (Figure 7).

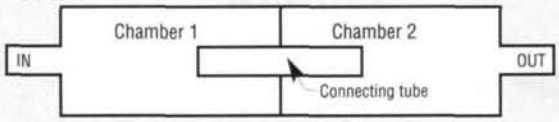
Muffler design is a complicated, time-consuming process and requires years of specialized training in many fields. But theory rarely translates into instantaneously successful sound-attenuating hardware. This is where the experimenter/entrepreneur fits into the picture. Exercising empirical methods, small companies have dominated the muffler aftermarket. This isn't all bad, as some remarkable designs have been produced, especially over the past two decades. The truth is, the muffler isn't the problem any longer; the propeller is the limiting factor for further reductions in noise!

Figure 1.



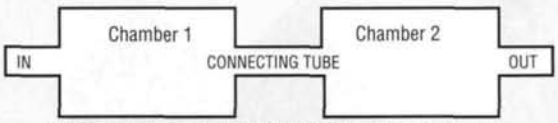
Helmholz chamber

Figure 2.



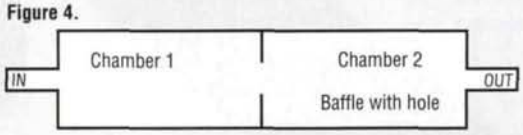
Two-chamber-expansion type

Figure 3



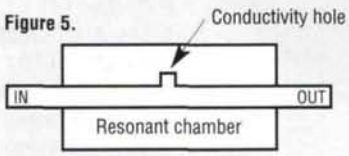
Two-chamber-expansion type with external connecting tube

Figure 4.



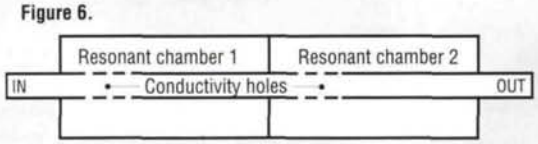
Two chamber-expansion type with internal baffle and hole

Figure 5.



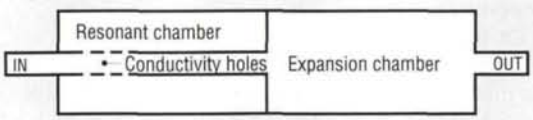
Single-chamber resonator

Figure 6.



Two-chamber resonator

Figure 7.



Combination resonator and expansion chamber

For further reading: Sound and Model Aeronautics (1991) from The Academy Of Model Aeronautics; "Hey! Keep the Noise Down!," D. Gierke, Model Airplane News, December 1995; "Sound Advice From Europe," Paulson, Model Airplane News, November and December 1995.

Smoke on ...

One of the oldest—and it's still one of the most impressive—ways of showing off with your model is to have a smoke system. Spewing out a smoky exhaust signature will make even a standard trainer stand out. For more advanced, aerobatics fliers, a smoke trail makes connecting maneuvers and maintaining a constant heading just that much easier by giving them a reference line. But what's required to produce smoke? The answer quite simply is smoke fluid and heat!

Heat the smoke fluid before putting it into the muffler so the fluid can vaporize. Because of the heat required, 2-stroke glow engines aren't the best candidates to make smoke with. The 4-stroke engine and 2-stroke gasoline engines, with their higher exhaust-gas temperatures, are much better suited to the task. Preheating it also prevents the fluid from cooling the muffler and thus defeating the process altogether. There are several excellent smoke mufflers available, but if you like to tinker, you can also make your own (see the illustrations for some ideas).

J&A Engineering
114 O. E. Ave.
Excelsior Springs, MO 64024
(816) 630-5140
■ Peacekeeper mufflers for Sachs and Zenoah engines; tig-welded and machined-aluminum-tube construction; bead-blasted finish for all popular single- and twin-cylinder gas engines—$49.95 - $165.

J'Tec
660 Pacific Ave.
Oxnard, CA 93030
(805) 487-0355
■ Snuf'ler muffler; smoke mufflers; 2- and 4-stroke Pitts style: $28.95 - $39.95; in-cowl—$26.95 - $38.95; Snuf'ler—$26.95 - $49.99; double Snuf'ler for gas—$64.95.

Mac's Products
7935 Carlton Rd.
Sacramento, CA 95826
(916) 456-6932
■ Mufflers, tuned pipes, headers, smoke system and complete pretuned bolt-on exhaust systems—$32.95 - $92.95; quiet pipes—$44.95 - $64.95; tuned pipes—$26.95 - $70.95; muffled tuned pipes—$38.95 - $58.95; pretuned—$80.95.

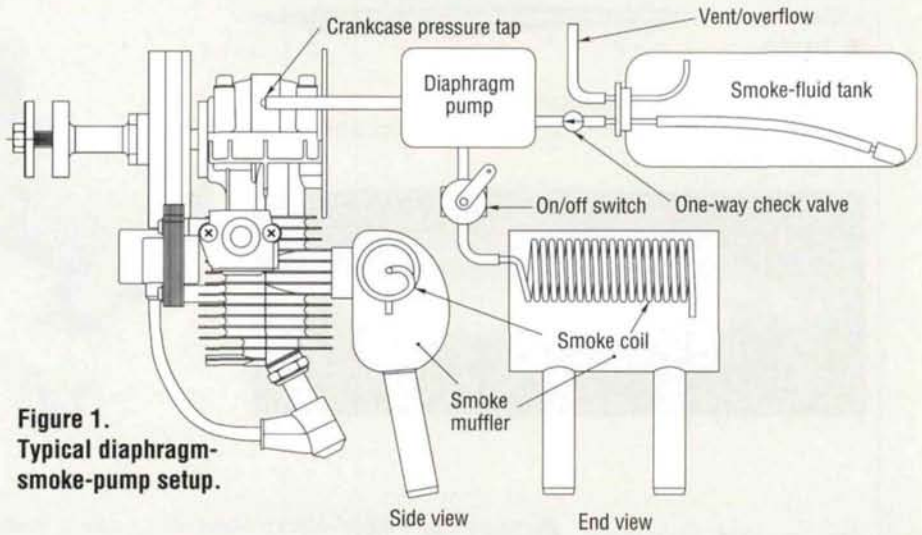


Figure 1.
Typical diaphragm-smoke-pump setup.

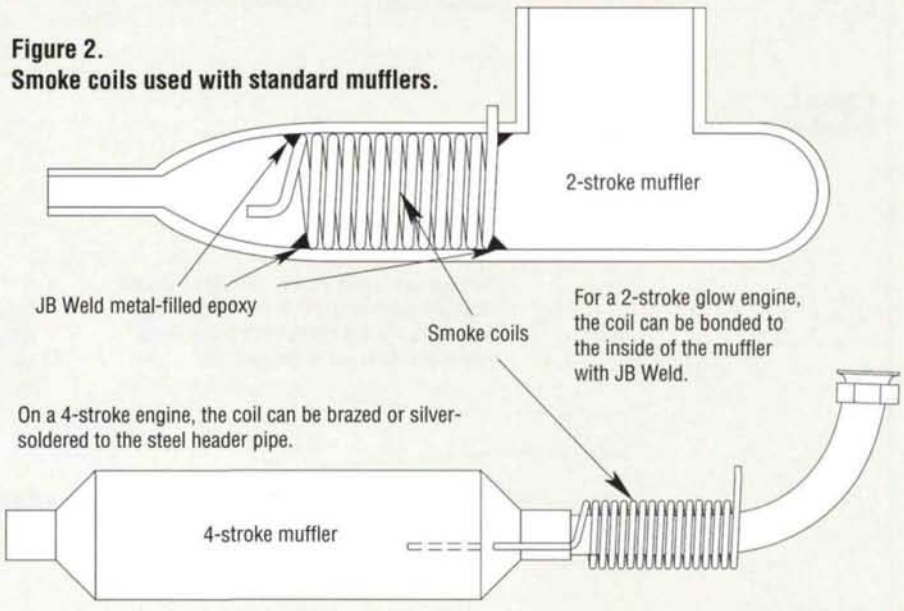
Getting smoke fluid into the muffler requires some sort of pump, which can be electric or a diaphragm pump run off an engine-crankcase pressure tap and a check valve.

Smoke fluids are available commercially, but modelers have experimented with a variety of oils and chemicals. Number 2 diesel oil, concrete form oil called Carvea no. 22 and a combination of automatic transmission fluid and Marvel Mystery oil are the most popular choices. But smoke fluid such as B&B Specialties* Bennett's Best Smoke Fluid is most convenient.

You also need a way to turn the smoke system on and off and a check valve to maintain the system's pressure. Again, several servo operated valves are available.

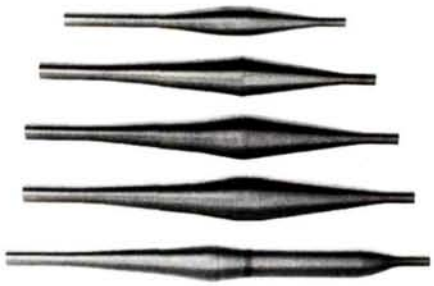
Smoke on!

Figure 2.
Smoke coils used with standard mufflers.

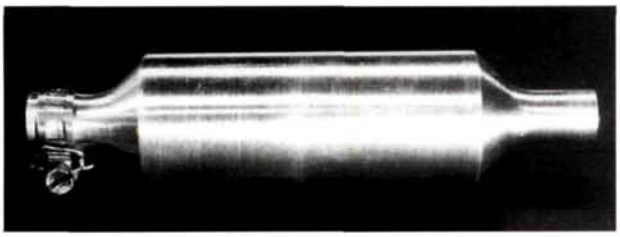


Prather Products

1660 Ravenna Ave.
Wilmington, CA 90744
(310) 835-4764



■ Tuned Pipes, after-Mufflers, couplers and brackets. Tuned pipes—$39.95 - $64.95; 7.5cc after-muffler—$19.95; 11cc - 15cc after-muffler—$20.95.



Slimline Mfg.

P.O. Box 3295
Scottsdale, AZ 85257
(480) 967-5053
fax (480) 967-5030

Smoke fluid pre-heater

■ Machined and brazed aluminum mufflers; all styles: 2-stroke glow, 4-stroke glow and gas engines; sport scale—$32.99; compact Pitts style—$37.99 - $44.99; 4-stroke—$64.99 - 119.99; large-volume Pitts—$48.99 - $89.99; giant-scale Pitts—$69.99 - $159.99; inverted Pitts—$64.99 - $99.99.

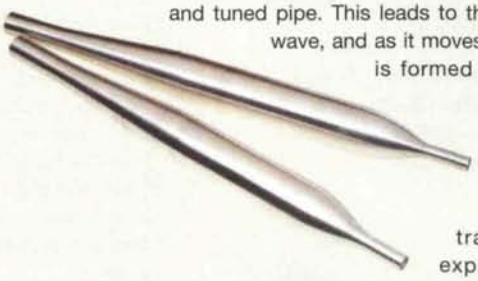
Top Flite

Distributed by Great Planes Model Distributors
P.O. Box 9021,
Champaign, IL 61826-9021
(800) 682-8948
fax (217) 398-0008
www.greatplanes.com.

■ In-cowl mufflers and headers for Top Flite scale kits; .61 - .75 muffler—$24.99; exhaust headers—$19.99.

Tuned-pipe theory

A tuned-pipe exhaust system works off pressure waves emitted from the engine's exhaust. When the fuel charge is ignited in the cylinder's combustion chamber, the piston moves downward in the sleeve. When the top of the piston reaches the exhaust-port opening in the sleeve, the hot exhaust gases escape and enter the exhaust header and tuned pipe. This leads to the formation of a pressure wave, and as it moves down the pipe, a vacuum is formed inside the cylinder. This helps to draw a fresh fuel/air mixture charge from the engine case up into the cylinder.



As the pressure wave travels down the pipe, it expands as it travels in the increasing-diameter divergent cone (see Figures 1 and 2). The action of these positive waves in the divergent cone causes a less intense negative pressure in the header area, and this draws some of the new fuel charge out of the combustion chamber. As the positive wave travels to the second part of the pipe (the convergent cone), it meets the increasingly narrow passage. Some of the wave exits through the small opening at the end of the pipe (the stinger), and the rest is reflected back toward the engine.

By the time the pressure wave begins its return trip to the exhaust port, the piston has reached bottom dead center and is on its way back up the cylinder to shut the exhaust port. If the length of the tuned pipe is correct, the fresh fuel charge in the header is forced back into the combustion chamber before the exhaust port closes completely. This packing of extra fuel back into the cylinder is referred to as "supercharging," and it greatly increases the engine's power output. If the pipe is too short or too long, the timing will be off and there won't be any supercharging. +

Figure 1. Tuned-pipe nomenclature.

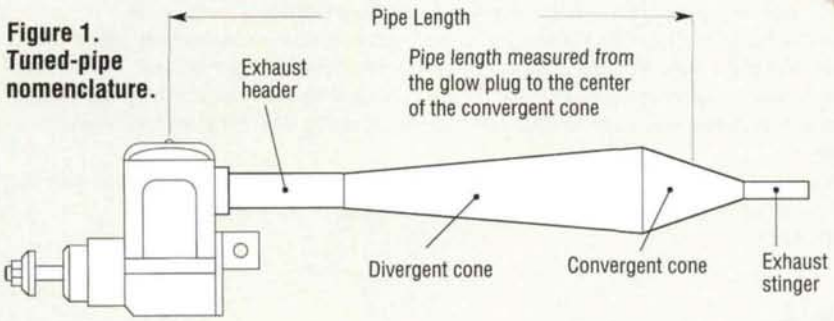
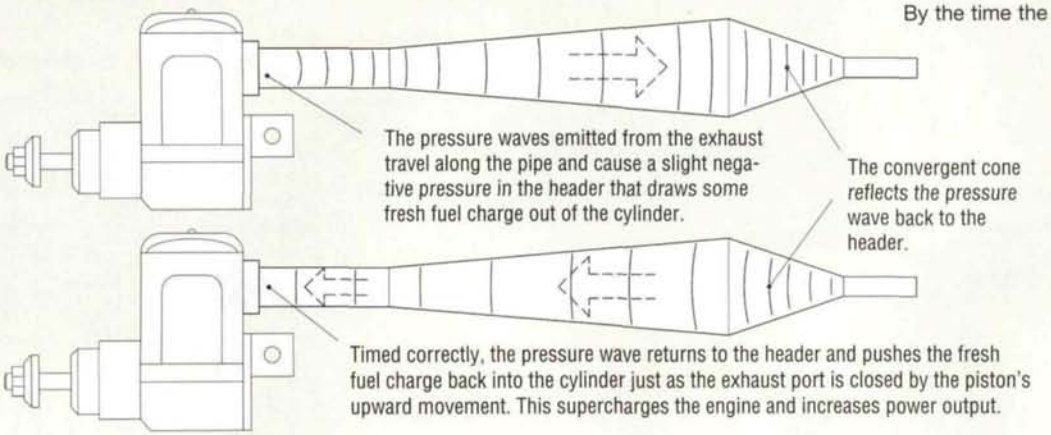


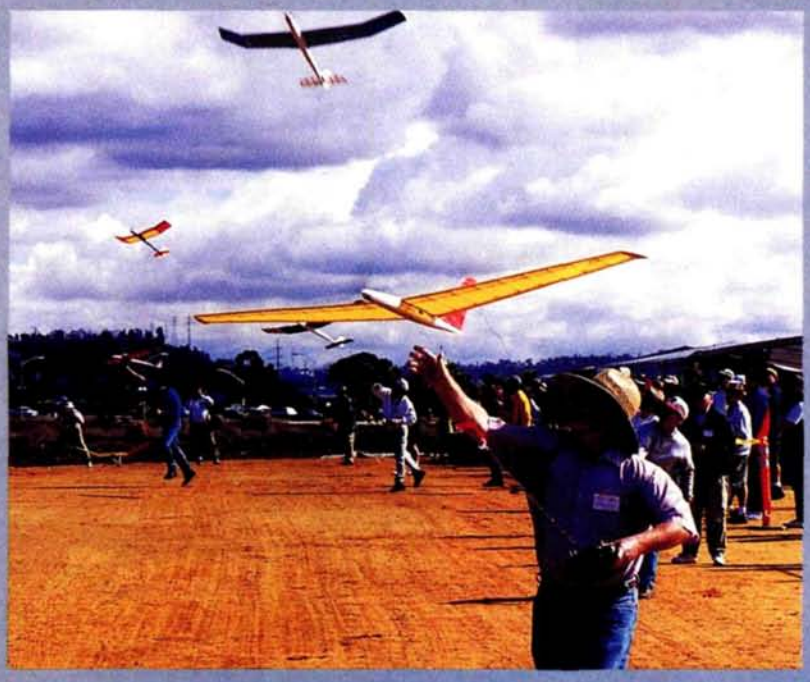
Figure 2. Tuned-pipe pressure waves.



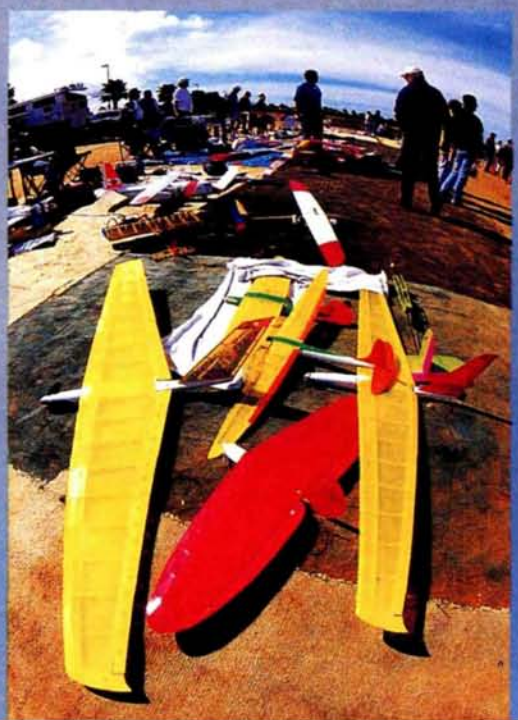
by Thayer Syme

SAN DIEGO MID ELECTRIC

Top: Steve Ciambrone's Sureflite Aircobra. Power is by an Aveox 1406-2Y, Astro super gearbox and a 12x8 prop. The 10, 2000mAh battery delivers 40 watts of static pull. The finish is silkspan with waterbased sanding sealer and Testors Model Masters paint. All-up weight is 60 ounces. From left to right: the Diversity Model Products Butterfly. A Speed 400 aerobatic park flyer kit, the 3-channel model has a 31-inch span and an all-up weight of 12.5 ounces on 7 cells. The kit is a combination of carbon-fiber and laser-cut balsa and includes all hardware. • Dick Oglesbee of Mountain View, CA, built this Kloud King Old Timer for his wife. She was nice enough to let him fly it in San Diego after he "wore out" the two models he brought. Geared Astro 05, 7x1400AE, 52-ounce, covered with Ultracote. • 1912 Eastbourne Monoplane by SEFSD member Fred Harris. This delightful early bird was a joy in the air, powered by an S-400 and mini-Olympus gear drive, 9x6 prop and 7,500mAh battery. It weighs 28 ounces all up and was built from a Pat's Custom Models kit.

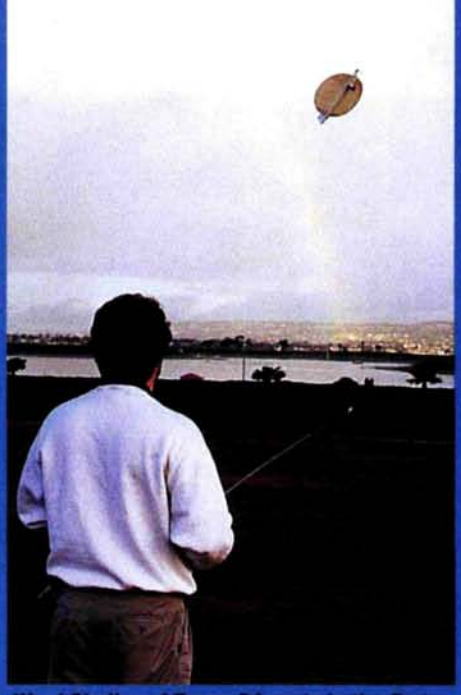


Quiet flights in Southern California



Above: Glenn Sparks of Yucalpa, CA, launches his original-design Miracle 72 in the LMR competition. Power is a Speed 400 geared 4:1 on 7, 600AE cells. Right: Glenn brought this collection of original design models. They flew just as good as they looked. Ranging in span from 40 inches to 2 meters, they are powered by an assortment of direct and geared Speed 400s and turbo 500s. They are all of conventional wood construction and covered with MonoKote. Background shot: San Diego modeler Steve Ciambrone's PT-19 built from a House of Balsa kit. It's powered by an Astro 05G, 10x8 prop and 10, 2000mAh cells. All-up weight is 64 ounces. The finish is Coverite's 21st Century fabric.

WINTER FLY



Ward Shelley of Tracy, CA, puts in the first flight of the weekend. Nearly hovering in front of the rainbow, he helped the photographer warm up with an easy one.

Below: this exceptional Schweizer 300 helicopter was built by Ed Sweeney of Black Forest, CO. The heli began life as a Century Hawk 3 and was modified with the scale fuselage.

Above: A modeler named Herb flew this modified Kyosho T-33A after reinforcing the wing with carbon and glass. An Aveox 1114/4Y motor does the honors, turning the Kyosho 3-inch fan on a 14, 1250SCR battery and a Kontronics sensorless ESC. Wingspan is 46 inches; weight is 54.4 ounces.

Below Inset: Ed Sweeney prepares to launch this fine Herr Engineering Helio Courier converted to RC. The Helio model is powered by a Puma TP-01 motor and 8, 650mAh cells

If you like flying, watching, or just talking about electric-powered RC models, here is a modeling tip you can't afford to ignore: make room on your calendar next February for the 2001 San Diego Mid-Winter Electrics (MWE)!

This year, I escaped some typical San Francisco winter rain and headed off to Southern California for the MWE, hosted by the Silent Electric Fliers of San Diego (SEFSD). I mean, how could I pass it up? Right there on the official SEFSD website (http://sefsd.org), it promised that I could "enjoy the best weather San Diego has to offer ...." So I jumped on a flight to San Diego, grabbed a rental car and, well, what do you know, it does rain in Southern California. Fortunately, it doesn't seem to rain much. The forecast was dire, but those who risked it were rewarded handsomely. It probably rained for less than 20 minutes total during all three days of the event. But enough about the weather; let's do some flying!

First thing Friday morning, we were treated to a welcoming rainbow as a background for a few quick flights. From then until late Sunday afternoon, the skies above the SEFSD field were quiet but busy. The SEFSD members enjoy the use of a strictly electric venue on Mission Bay, within sight of Sea World. The field is well maintained, with carpeted pits and a soft, forgiving mulch surrounding the runway. The runway is dirt, because irrigating grass on what had been a landfill is not permitted. The Mid-Winter Electrics 2000 saw 75 to 80 registered pilots, more than 150 models, a dozen or so vendors and countless spectators descend upon the field.

Everyone seemed to have a great time, no matter what their interests. The SEFSD takes full advantage of this site to promote all phases of electric-powered RC aeromodeling.

Above left: Bruce DeVisser of San Jose, CA, built this model of a Horizon Airlines N328PH. It has a 52-inch wingspan and is powered by two Speed 280 motors. Above right: Steve Toschi proudly displays half of his pair of matching molded MiG 15s. With a 58-inch span and weight of 50 ounces, this model is a real barnburner, despite being the slower of the two! For those who feel the need for speed, a kit will soon be available from RnR Products. Below and right: NA-73X (aka the prototype P-51) by SEFSD member Jack Hix. First in San Diego Scale, this 31-inch-span, 20.3-ounce beauty is powered by a direct-drive Astro brushless 020. Its radiator is functional; it provides cooling air for the motor through an extensive cooling duct. The detailed landing-gear strut is really a dummy made of aluminum tube and plastic. The finish is chrome, aluminum and black MonoKote.

In a moment of inspiration, a Speed 400-powered foam 747 sheds its fuselage for an extra wing!

Each morning began with a welcome address and mandatory pilots' meeting. After that, you were welcome to fly as much and as often as you liked, as long as an event wasn't being held.

Special events, including old-timer pylon racing, Speed 400 F5B and pylon racing, Dragonfly pylon racing, Mad Dog Mayhem (full-contact combat), limited motor run (LMR) glider toss, scale flight and exhibition were held throughout the weekend, with open sport and scale flying between competition heats.

Dragonfly racing occurred right over the runway area, with a few traffic cones serving as pylons. It was a delight to see these wonderful models from Diversity Model Aircraft contest the airspace as they flitted slowly about the pylons. This model is designed to be easy to fly and is an ideal trainer. All other events were held on the pylon course.

Scale judging was in the pit area, with qualifying scale-exhibition flying taking place in any open flying period. The scale models were truly remarkable and ranged from pre-WW I to modern day. There were two scale classes for competition.

"San Diego Scale" is a local class, restricting wingspan to 50 inches to encourage smaller, less expensive models. First place was awarded to Jack Hix for his NA-73X, the prototype for the venerable P-51. This gorgeous model was covered in chrome MonoKote and had many unusual scale details and systems. Second place went to Steve Toschi for his pair of molded MiG 15s. Launched from a bungee, these exceptional aircraft put on an amazing show. If you fancy yourself a jet jockey, look out for an RnR kit based on these prototypes. The models really were spectacular, both on the ground and in the air. Third place went to Jack Roesch and his Farman Moustique from the old Flyline kit.

"Open Scale" is just that: open to any scale electric model. First place went to Brian Chan and his ¼-scale Great Planes ARF Spacewalker. Visiting from the San Francisco Bay area, Brian brought a car full of models. Powered by an Aveox motor, this model has a 79-inch span and weighs 13 pounds. Steve Ciambrone took second place with a beautiful House of Balsa PT-19 conversion. Third place went to Ed Sweeney for his exceptional Schweizer 300. Although it's equipped with a three-rotor head, it was officially flown with a 2-blade setup.

The LMR events included both Speed 400 and Open classes. Gary Westland won the Speed 400 class, followed by Don Wemple and Bob Taylor. Ward Shelley won the Open LMR class, followed by Ron Shork and Jeff Keesamon.

Speed 400 pylon racing has come a long way! These little rockets are in the 100mph range. With little surprise, the event was won by Steve Neu, followed by Bill Knoli and Don Wemple.

On a much less formal note was Mad Dog (full-contact) combat. The object here is pretty simple: kill or be killed or, in this case, knock your opponents down. If a model touches the ground, it can't continue. The Mad Dog is a full-house performance ship that's designed to be thrown away after too much rough and tumble. It flies quite well on a Speed 600. To see so many similar outlines in the sky makes orientation tough; I am sure some of the maneuvers were due to losing track of the model!

Top: Dave Darling of Modesto Soaring Products and a happy customer pose with the Paribile flying wing from France. This unique model is available as a 12-ounce HLG, as well as with a Speed 400 power pod. Of special interest is the fact that it's made out of fiberglass rod and Dacron. Above: this spectacular molded carbon and glass sailplane is the Xenath from Cavazos Sailplane Design. Spanning 114 inches, it is designed for 7-cell LMR. Power is an Aveox 7LMR on 2000mAh cells. The 14x9.5 CAM prop draws 80 amps. All-up weight is 82 ounces.

At the MWE 2000, there was a lot of compelling evidence that the e-powered ducted fan has nearly come of age. A lot of Kyosho jets had been re-powered with Aveox and Astro motors, and they were flying fast!

Look for a new Beech 18 kit from K&A Models. Designed for 6-channel control, the plane will be powered by a pair of Magnetic Mayhem motors and belt drives and will include a well-molded fuse and foam wings.

The end of flying each afternoon was not the end of entertainment, nor of good company. On Friday evening, the club sponsored a symposium on Electric Flight at the San Diego AeroSpace Museum in Balboa Park. It was well attended, and I believe that everyone learned something new.

After brief introductions from coordinator Don Wemple, Tom Hunt of Modelair-Tech opened with a talk titled "Stall, Spin, Crash and Burn: Prevention by Design and Modification." A Grumman engineer, Tom offered a lot of insight to some of the problems in model design and flying and what we as modelers can do about them. He included tips for modifying airfoils and planforms as well as basic flying techniques to help our models last.

Next up was "The Electric Scale Experience" panel discussion with Fred Harris, Bill Allen and Jack Hix, with Don Wemple as the moderator. This was not restricted to the expected dialogue about trying to save weight, keeping a model light and not carrying anything extra. We also learned what the panelists looked for in potential new projects, possible problem areas in design and a few finishing and detailing tricks to save time while building a better model.

The third presentation of the night was given by Doug Chronkite. For those not in the know, Doug is very competitive with an aerobatic model and is developing an electric-powered model he hopes will dominate FAI competition. Although FAI is a very specialized discipline, all the attendees were rewarded with many new ideas about just what it takes to design, build and test-fly a new aerobatic model.

Saturday evening continued the tradition of a Mexican feast at the nearby Marina Village, where we were all engrossed in swapping stories of modeling adventures. Sunday came much too soon, as we quickly approached the awards presentation and raffle drawings. Special thanks are due the Mid Winter Electrics 2000 coordinator Don Wemple. He and his team of volunteers did a great job with this, just the third annual fly-in. This event should have a great future.

Can't wait until next February for MWE 2001? Well, pack your bags; the SEFSD is hosting the International Electric Flight Festival from August 2 to 6 and the Electric World Championships 2000 (an F5B/F5D event) from August 6 to 12. For more information, visit the SEFSD website at http://sefsd.org, or contact Mike Neale, 17140 Tam O'Shanter, Poway, CA 92064.

Top: this Fokker Dr.1 is the work of Jack Roesch. Built from a Guillows free-flight kit, it has a 20-inch span and is covered with MonoKote and Ultracote. Center: another molded beauty from Steve Toschi. This one-piece sport model is fully molded with hollow-core wings. It weighs 30 ounces and has a 32-inch span.
Bottom: Fred Harris of San Diego put together Sky Video. It is a 72-inch-span Dragonfly. The 12-ounce video system is largely pieced together out of closed-circuit, video-conferencing gear. Sound and a color picture are transmitted to the ground at 2.4 ghz during flight.

SAN DIEGO MID-WINTER ELECTRICS 2000 SPONSORS

Special thanks go to the following companies for their promotion of electric modeling:

AstroFlight
Cavazos Sailplane Design
Diversity Model Aircraft
Dymond Model Sport
Electric Jet Factory
Hobby Club
Hobby Shack/Hobby People
Hobbyflite Inc.
K&A Models
Leisure Electrics of Downey
Modelair-Tech
R/C Design & Mfg.
RC Direct
ShredAir
Sirius Electronics

by Bob Hastings

Great Planes SPIRIT

BUILT-UP AND ARF GLIDERS

Main image: the Spirit Elite Kit lets the builder choose many wing configurations and options. Right: the colorful ARF Spirit has a two-piece polyhedral wing, spoilers and can be built in about two hours.

KIT SPECIFICATIONS

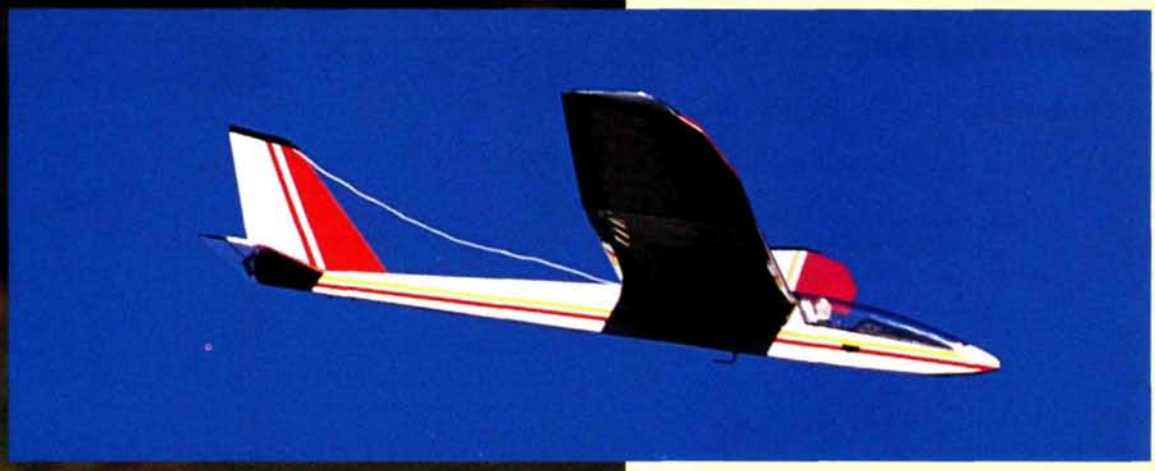
Model: Spirit Elite kit
Manufacturer: Great Planes
Type: glider
Wingspan: 78.5 in.
Wing area: 645 sq. in.
Airfoil: SA 7035 at the root and SA 7036 at the tip
Weight: 33 to 35 oz.; review model weight: 42 oz.
Wing loading: 7.3 oz./sq. ft.; review model: 9.3 oz./sq. ft.
Length overall : 46 in.
Radio req'd.: 4- to 6-channel w/4 to 6 microservos
Radio used: Futaba 6XA
List price: $64.99

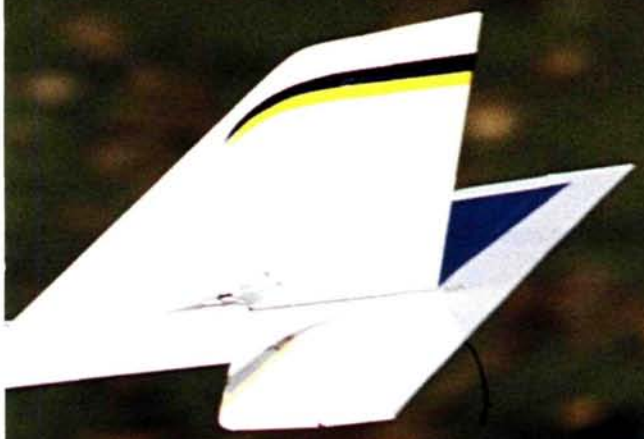
Features: low-drag design with advanced airfoils for speed and wind penetration; engineered to take full advantage of computer radio mixing; die-cut interlocking wood parts for strength and easy assembly; lift off, vacuum-formed canopy conceals radio compartment; can be built with a polyhedral or straight wing; two-piece, bolt-on wing for ease of transportation; ideal for slope soaring, high-start, winch and aerotow.

Comments: the glider went together fairly easily with only a couple of minor problems (see text). Some handy tips in the manual help with the covering process, and the glider flies beautifully. It is good for intermediate to advanced glider pilots.

Hits
- High-quality die-cutting.
- Nice-looking glider that soars well.
- Good packaging of materials.
- Wing has ailerons and flaps.

Misses
- Lack of step-by-step written instructions.
- Some wood slightly warped.
- Incorrect canopy hold-down position.





There's a silent beauty in all things that soar. I've often watched with awe the hawks that lazily circle our flying field. Even the seagulls that thermal off the parking lot at the mall have a grace all their own. Naturally, thoughts of an RC model rising on that same prime updraft came to mind, but unfortunately, a sailplane just wasn't possible for me—at least, I thought so at the time. If you believe that there's no glider in your future, I'm glad I caught your attention! Great Planes* offers two gliders that dispelled all of my preconceptions about owning a glider:

I didn't have time to build one, and it wouldn't fit into the car or workshop when completed. Those reasons didn't matter when I had to decline an invitation for slope soaring and seafood on Cape Cod just because I didn't have a suitable plane. Timing is everything: Great Planes luckily had just released an ARF version of its Spirit Elite that has detatchable wings and a bolt-on tail. My first call was to Great Planes and the second to the gang in Massachusetts.

ARF SPECIFICATIONS

Model: Spirit ARF
Manufacturer: Great Planes
Type: glider
Wingspan: 78.5 in.
Wing area: 676 sq. in.
Weight: 35 oz.
Wing loading: 7.4 oz./sq. ft.
Length overall: 39 in.

Radio req'd.: 2- to 3-channel
Radio used: Tower 4-channel
List price: $149.95

Features: quick and simple assembly, balsa and ply substructure, polyhedral wing, distinct top and bottom graphics, optional spoilers, vacuum-formed canopy and pilot.

Comments: this Spirit ARF is highly visible, easy to assemble, transport and fly. It's a good value and a great introduction to sailplanes.

Hits
- Can be assembled in less than 2 hours.
- Forgiving flight characteristics.
- Attractive price.
- Highly visible 5-color MonoKote scheme.

Misses
- Covering had to be reshrunk.

By the time I had the Spirit ARF unpacked and on my workshop table, I was already chuckling as its design immediately dispelled my concern that I wouldn't have time enough to build it. It has about two dozen pieces, including the individual hardware components. It's as though Great Planes began with an assembled plane and told somebody to just break it down enough to fit it into the box. The glider has a two-piece polyhedral wing, and its main structure is of balsa and ply. Other than that the MonoKote needed some attention with a heat gun to remove a few wrinkles, the plane's overall workmanship is very good. The combination dihedral brace and wing joiner is a sandwich of two aluminum angle braces that I glued to a

Continued on page 46

ARF FLIGHT PERFORMANCE

Did I mention that I've never flown a glider, much less owned one. Before you scoff at my ability to accurately evaluate the Spirit ARF, remember that this is an entry-level 2-meter ship, and that makes the Spirit and me an ideal match.

• TAKEOFF AND LANDING

I did a few trim hand-launches in the back of our local hobby shop. There's something almost disconcerting about flying a glider: your mind says, "Here's a big plane at low speed; it shouldn't be flying." The Spirit ARF, courtesy of its light wing loading, will do another two circuits of the field from the time you think it's ready to drop. For its size, the plane hand-launches easily, and the polyhedral wing is self-leveling. My heart rate elevated considerably with the ARF hooked on the high-start line. With a hefty batch of acceleration and wind noise, the Spirit ARF shot up as though it it had booster rockets attached. I had to hold in right rudder until its acceleration slowed, but all went well. Before I could do anything about it, it was soaring—no tuned pipe, no exhaust trail, no noise—it's exhilarating. Of course, I was obligated to yell "dead-stick" when I felt comfortable. Landing requires that you rethink your usual timetable. The downwind, base and final approach are done slower and farther away. I found it easiest to try to

THE SPIRIT ELITE KIT *by Roger Post Sr.*

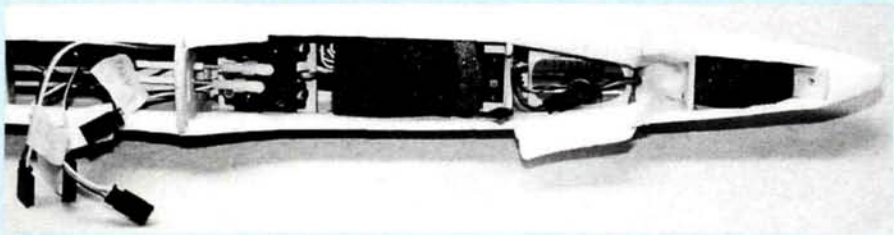
The Spirit Elite can be built with a straight wing or with a polyhedral one; I built the straight wing because I wanted to experiment with flaps and ailerons for more sophisticated flying. This is not a model for beginners. Instead of the step-by-step construction notes I have seen in other Great Planes kits, you need to accurately interpret the drawings of the building process. I'll touch on some points that will simplify this.

• I built and sanded the tail surfaces according to the indicated taper on the plans, which, by the way, are well drawn. The fuselage goes together quickly. It's easier to position and secure the three towhook blind nuts before you install the pushrod tube. Also be sure that the pushrod tubes fit easily through the holes in bulkheads F-14, F-15 and F-17 before these formers are glued into place. Sand and finish the fuselage per the instructions and set it aside.

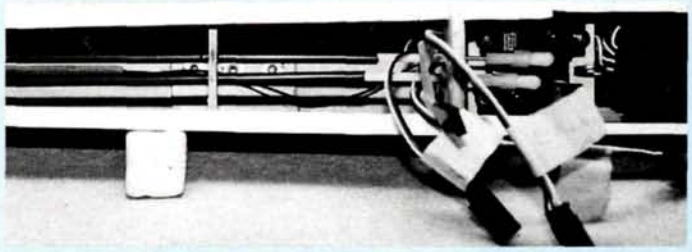
• There are many important notes in the wing construction, so read them carefully. You'll first need to decide whether to build the straight wing or polyhedral version. I used Great Planes' 30-minute epoxy to construct the wing joiner, joiner boxes and the inner and outer wing-panel joints. The wing is built upside-down and, to avoid confusion, study the drawings carefully. In drawing 10, the wing joiner is drawn upside-down—not the way it is actually installed. This is only for a trial-fit to ensure that the wing-joiner box is wide enough to accept the joiner.

• Once you've constructed the inner panel, build the outer panel. The step for cutting off the rib-jig tabs on the outer panel was omitted from the instructions, but you should do this before you continue. If I were to construct another wing, I would build the inner and outer panels as one piece for more strength. When I had joined the panels, I cut the tip blocks, ailerons and the flap trailing-edge stock to shape, then I glued and shaped the tip blocks. (I did have some slightly warped aileron stock in my kit.)

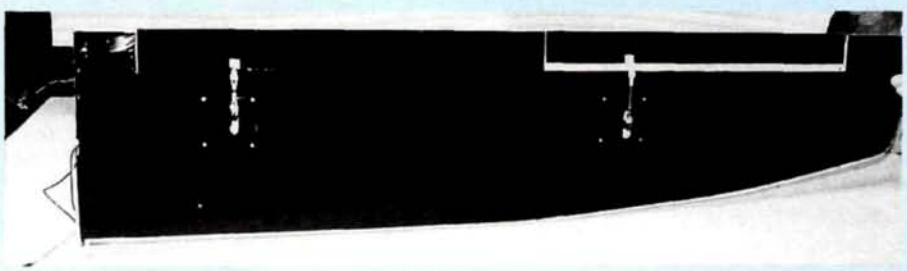
• I glued the wing-bolt plates into position and mounted the wing on the fuselage. Make sure you mark and drill the mounting holes accurately. Use a 10-24 tap to thread the wing-mounting block in the fuselage. When I installed the canopy using the rubber band as instructed, the canopy wasn't aligned. Instead, I installed a small hook screw in the forward servo rail, and that pulled the canopy down into its proper position. After covering the glid-



The Spirit's design makes efficient use of limited space for all of the radio gear.



Options such as ailerons, flaps and plug-in wing panels require many servo leads. Identification tags are essential for field setup.



set up for a short "weedeater" landing; I was long every time!

• LOW-SPEED PERFORMANCE
The inherent stability of a polyhedral-wing glider is amazing. If you have the radio, I recommend that you use the optional spoilers. The light wing loading is great until you run out of field. If you attempt to force a landing, the additional speed when the glider reaches ground effect usually leads to a wingtip pirouette. I never damaged it when this happened, but be aware that your entire landing approach to touchdown needs to be set up differently.

• HIGH-SPEED PERFORMANCE
The only portion of flight I would consider "high speed" is during the bungee or winch launch. The wing has withstood these stresses without a hitch. Remember that converting altitude into airspeed is the only throttle available; this makes you less likely to waste "gas."

• AEROBATICS
Any type of stunt flying requires that you be well studied in lessons of power management. It's sort of like playing chess: you have to envision the outcome of your actions prior to executing a maneuver. With sufficient airspeed and altitude, the Spirit performs lazy loops and rolls.

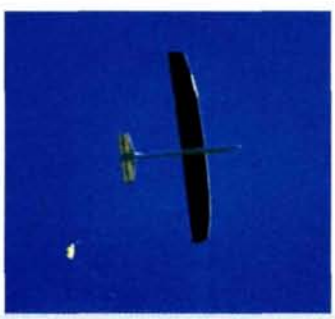
The Spirit ARF is a far cry from the more extra-caffeine planes that I've chosen over the years. It combines the excitement of the launch, the thrill of the thermal hunt and the challenge of precision landing all in one vehicle. I've become very fond of the techniques and artistry involved in unpowered flight. If you've done nothing but glow until now, I encourage you to catch the Spirit!

er with MonoKote, I hinged the control surfaces and glued the tail into place. I installed my Futaba* radio gear and attached the wing so I'd be able to balance the glider properly. The manual has great tips regarding towhook location, flying and advanced features such as thermalling, slope-soaring and adding ballast. Look them over before you go flying.

THAT'S A WRAP
For the intermediate to advanced builder, this kit should be easy to construct. I found it easy—although lengthy—to build. The results are a very good-looking model that thermals well. I enjoy flying it and now find myself constantly checking the weather for good thermalling days. The Spirit Elite is another fine model from Great Planes.

KIT FLIGHT PERFORMANCE

• TAKEOFF AND LANDING
Use a high-start, electric winch, or throw it off a slope, I used the Dynaflite* Hi-Start. There's plenty of zip in the high-start's rubber tube, and it will quickly get the glider to 300 feet.. Keep the wings level on the way up, and use the rudder to keep the tracking straight. By lowering the flaps (15 degrees) and ailerons (5 degrees) via computer mixing, you can add some camber to the wing; this will produce a steeper climb and a higher release altitude. Let the glider fly off the high-start by itself, and you're on your way to thermalling. To land the Spirit Elite, set up the downwind and base leg a little higher than normal, and once you have the glider established on final, deploy the crow mixing (flaps go down; ailerons go up). You'll need to add some elevator trim—in this case, down trim—to keep the glider on a steep descent path. When set up correctly, crow will act as a speed brake and spoiler, so make sure you can adjust it incrementally via the throttle stick. You might momentarily need to take some crow out if you happen to undershoot the approach. The Spirit Elite settles to the ground smoothly for a gentle touchdown that requires a slight flare. When you become proficient with the use of crow and how the glider handles, you can land it in a very short distance.



• LOW-SPEED PERFORMANCE
This is where the glider excels. It soars well in a strong thermal, making shallow banked turns and gentle climbs and dives. If you are not proficient at using the rudder stick, it will be necessary to couple the rudder to the ailerons. Since the Spirit Elite has a flat-bottom, high aspect ratio wing, it is prone to adverse yaw. So, to prevent it from initially turning in the opposite direction of the stick movement, rudder must be added to bring the nose around with the turn.

The Spirit Elite has a gentle stall, but it will lose some altitude in the recovery process. Don't stall it close to the ground unless you are going for a spot landing.

• HIGH-SPEED PERFORMANCE
The Spirit Elite will gain speed in a dive, but be careful during the recovery. A sharp pullout could possibly stress the wing beyond its structural limit. The fastest speed that I attained with the glider was during the high-start launch. After that, the Spirit Elite just floated around looking for thermals.

• AEROBATICS
Big, gentle loops, stall turns, spins and lazy eights were the only aerobatics I tried. As in the high-speed performance, a very gentle pull was used for all dives for airspeed. To accomplish the spin, stall turn and lazy eights, the rudder must have a large amount of deflection.

Overall, the Spirit Elite is a great thermaller, and once you become accustomed to its flight characteristics and all of its mixing possibilities, it can provide hours of soaring fun.

GREAT PLANES SPIRIT

Continued from page 44

wooden spacer. Dry-fit the joiner into a main spar sleeve in the root of the wing panels and the wing assembly is complete! When the wing is rubber banded to the fuselage, the panels are compressed with sufficient pressure to prevent them from parting company.

The vertical and horizontal stabilizers are both embedded with two threaded rods. The rods are pushed through predrilled mounting holes in the fuselage and are simply bolted into place. This arrangement ensures proper alignment and is also quick to break down for transportation. The control surfaces on the stabilizers have already been hinged and glued. After I had added the control horns, the radio gear and some final cosmetic details were all that remained to be done.

The wooden servo rails slide into side grooves in the fuselage interior. I like this arrangement because it allows the approximate placement of radio gear and any balance fine-tuning is a matter of positioning the servos. I installed a pair of Hobbico* CS-15 servos and the receiver for Tower's* inexpensive 4-channel radio. After I had connected the pushrods, I painted the included pilot figure with Parma's* FasKolor, glued on the canopy and attached the high-start launch. If you have a third channel on your radio, the Spirit ARF has spoilers already built into the wing panels! They're activated by a string that's attached to the spoiler's leading edge and run to an extra fuselage-mounted servo. This is handy when your approach is a bit hot and when you need to exit safely from a strong thermal. I really applaud this extra touch. If you decide to go with this option, cut the covering around the spoiler's sides and trailing edge. Start to finish, the whole assembly took only about two hours.

My desire for trunk capacity hasn't yet overcome my yearning to keep my turbocharged sportscar. Despite my shortage of space, the Spirit ARF is easy to transport. It takes only about three minutes to remove the rubber bands, disconnect the control horns and undo the four tail bolts. I've actually found it easier just to remove the vertical fin; the fuselage comfortably slips into my hatchback without being crowded by the high-start or the field box.

The Spirit is a good value and a great change of pace. Whether you hand-launch, slope soar, high-start or have it towed up with another RC plane, it's an exciting new challenge. Now that nothing prevents you from owning a sailplane, what are you waiting for?

**Addresses are listed alphabetically in the Index of Manufacturers on page 142* ✈

MODEL AIRPLANE NEWS
FIELD & BENCH
REVIEW

SPECIFICATIONS

Model: Ultimate .46 ARF

Manufacturer: Global Hobby Distributors

Type: ARF aerobatic biplane

Wingspan: 43.5 in.

Wing area: 761 sq. in.

Airfoil: symmetrical

Weight: 6 lb.

Wing loading: 18.2 oz./sq. ft.

Overall length: 48 in.

Radio required: 4-channel w/4 servos

Radio used: Airtronics RD6000

Engine rec'd: .46 to .53 2-stroke or .52 to .80 4-stroke

Engine used: Magnum XLFS .91AR 4-stroke

Prop used: Master Airscrew 14x6 Scimitar Wood Series

List price: $310

Features: prejoined wings; a completely built and sanded airframe that's covered with sag-resistant polyester film; lightweight construction; four-color scheme that includes a prepainted cowl and wheel pants; clear, molded-plastic canopy; finished interplane struts; factory-shaped and installed, easy-to-adjust aluminum cabane struts and an internally braced tail group. The kit also includes: a fuel tank, engine mount, landing gear and wheels, pushrods, clevises and horns, decals and a photo-illustrated final-assembly manual.

Comments: flies smoothly, and with a large engine attached to the nose, it really "rips" around the field. If you are an advanced pilot, you will particularly enjoy this model, although you don't need to be an advanced flier to enjoy its performance.

Hits

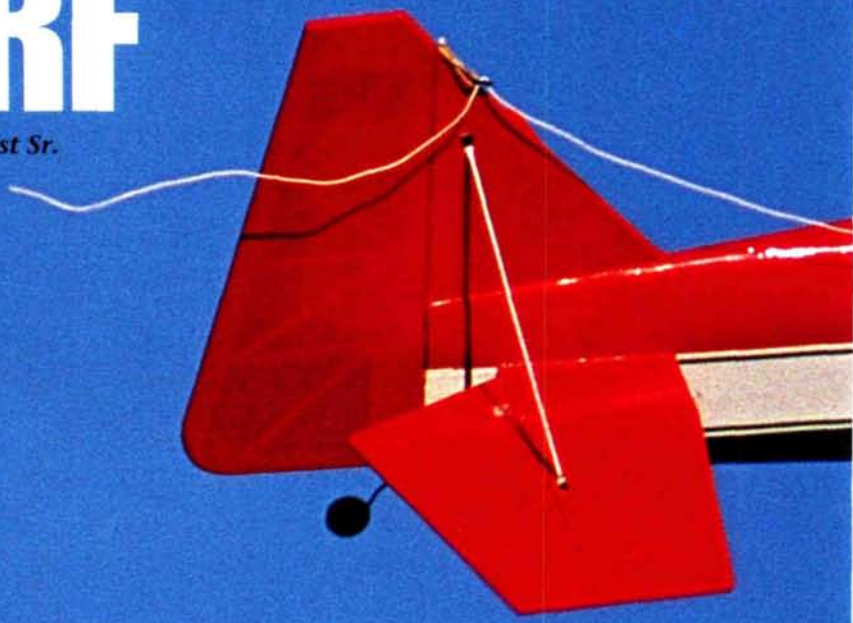
- Prejoined wings.
- Prebuilt and installed cabane.
- Assembled and painted cowl and wheel pants.
- Easy to assemble.

Misses

- Tires are too spongy and soft to withstand long-term use and tend to flatten under the weight of the plane.
- Blunt leading edge on center of top wing—more of a cosmetic rather than a flight detraction.
- Wheel-pant hole alignment causes cosmetic asymmetries (see text).

Global Hobby Distributors ULTIMATE BIPLANE .46 ARF

by Roger Post Sr.

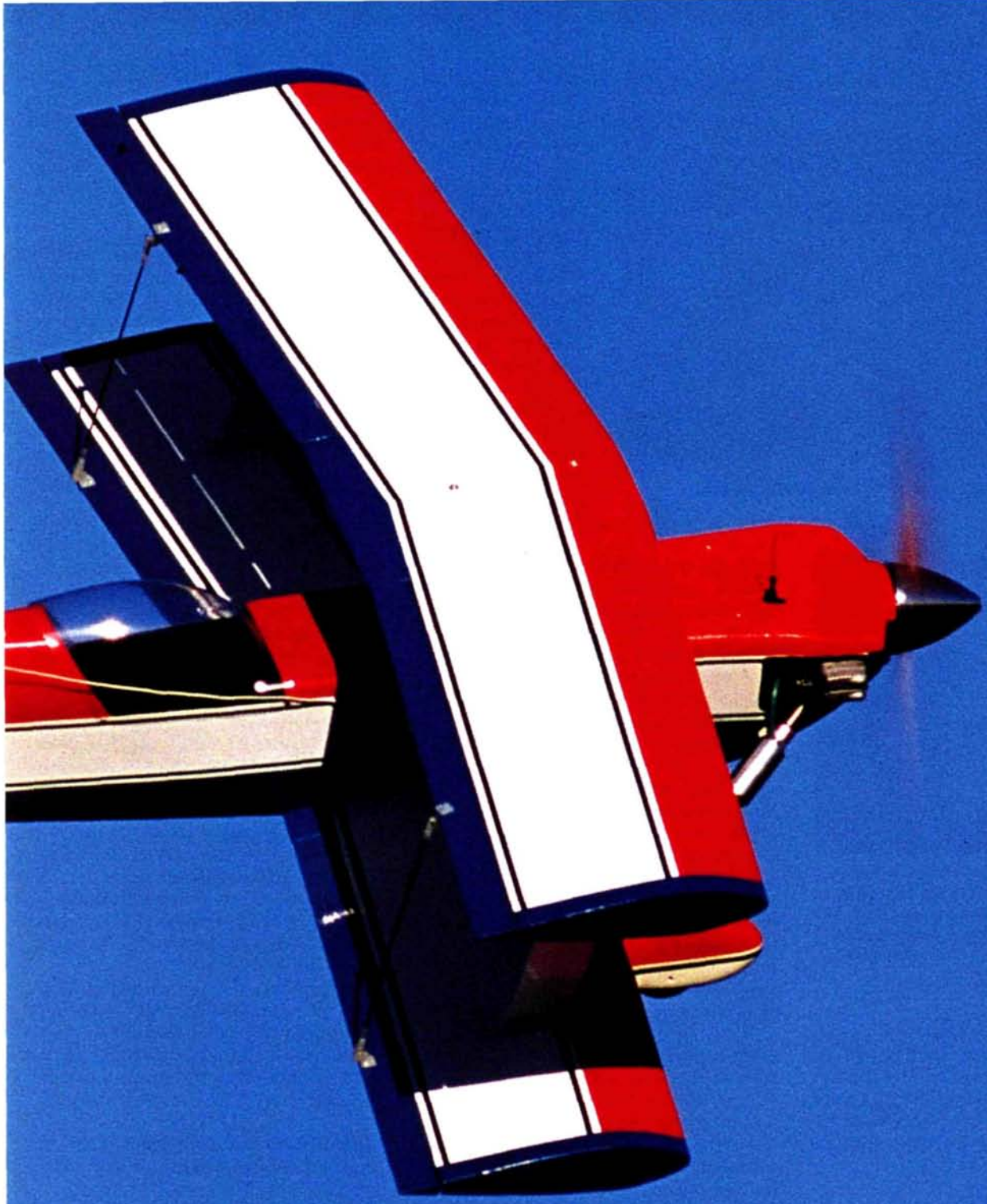


A popular aerobat you can assemble quickly

These days, for most of us, time is scarce. Well, the good news is that manufacturers of ARFs (and all of the variations) have honed the construction/assembly process down to a bare minimum so that the time needed to "build" a model is relatively short.

Global Hobby Distributors* has taken the ARF concept to the next level by giving us the Ultimate Bipe .46 ARF, which comes with its two wings completely assembled. No more gluing wing-spar pieces and aligning and gluing wing halves together. These wings, like the rest of the kit, are beautifully built, sanded and covered with polyester covering. The kit also comes with mounted cabane struts, a painted fiberglass cowl and molded wheel pants and hardware.

So what do you have to do to get this stunt plane into the air?



CONSTRUCTION

First, read the entire instruction booklet and identify the parts because it will save you some time when you're further along in the assembly. Inspect the covering, and seal any edges that aren't completely sealed with your covering iron.

No step-by-step analysis here: the manual is self-explanatory. Take a look at the flight-performance section in this article, and if this plane is for you, the following construction comments will supplement the manual. If you buy the plane, you'll want to keep this article for detailed reference during assembly. I'll offer some discretionary tips that will ease the process for you.

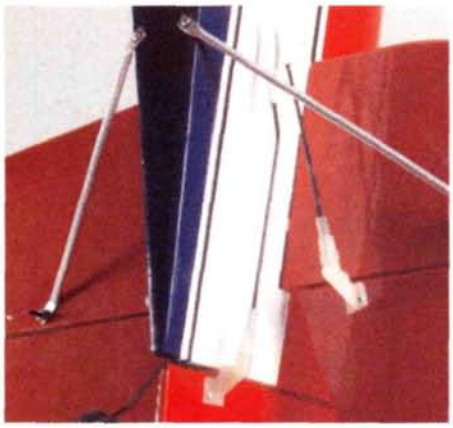
• **Bottom wing mounting.** I had to elongate the hole in the forward former that accepts the wing dowel so that the wing would sit in the saddle properly.

When you remove the ailerons, mark them on the inside end with a felt-tip marker so you will be able to put them back in their original positions, e.g., BL (bottom left), etc. When you've mounted the bottom wing, seal the balsa portion of the wing-mounting block with thin CA.

To add a measure of insurance and longevity, use locking washers and a piece of hard plastic under each of the wing hold-down bolts. I cut two, ¾x⅜x1/16-inch plastic pieces out of a scrap piece and drilled them out. They work well, and the wing-bolt doubler will never be crushed by the small washers.

• **Horizontal stabilizer mounting.** When you remove the covering that's over the slots that accept the horizontal stabilizer, be sure not to remove the covering on the precovered wooden spacer on the fuselage. Mark the elevator halves with the marker (I did this on the forward edge of each surface so the marks wouldn't be seen). Carefully use a sharp razorblade rather than a pen to mark the area where the covering should be removed from the horizontal stabilizer.

The Ultimate is largely prebuilt when it comes out of its box.



So that the rudder control linkage will align with the rudder control horn without binding, I purposely bent the tail-end of the rudder's threaded rod inward to meet the rudder control horn (see detail). The tail wires are functional.

• **Vertical stabilizer mounting.** Again, use a sharp razor blade. Do not remove thecovering from the aft edge of the fin. I had to to mount functional flying wires on the tail surfaces because when the rudder was fully deflected, the vertical fin moved laterally.

• **Top wing mounting.** First loosen the nuts inside the fuselage that hold the cabane struts in place. On the outside of the fuselage, pull the bolt and washer away from the fuselage and apply some CA to the bare balsa. This will strengthen the wood and will help to fuelproof it. Now tighten the nuts so that when you apply some pressure to the cabane structure to move it up or down, you feel some friction. The nut should be tight enough to allow the structure to be moved, but it should be able to stay where you put it without succumbing to gravity.

This next manual section has three subheads: "Align the top wing," "Installing the interplane struts" and "Mounting the top wing." As I went through the first two sections, I found an alternate way to do the procedure that you may prefer (your choice).

First, set up the wing incidence as described in steps one through six under the "Align the top wing" subhead. Then go to step eight. It states that there are two predrilled holes in the bottom of each interplane strut. They apparently overlooked the predrill on the model I reviewed, so I placed the struts in the bottom wing and marked where I should drill the holes through the holes in the strut mounting blocks.

Next, secure the interplane struts to the bottom wing (steps 10 through 14), and then attach the bottom wing to the fuselage. Place the top wing (with the ailerons removed and properly marked) on the tops of the interplane struts. Slide the wing onto the struts very carefully so you don't snap one of them in half. With the top wing pushed down completely into place, check the incidence and set it to zero or minus 1 degree (your preference).

Carefully raise the cabane struts so the tops of these struts touch the bottom of the top wing. Recheck the incidence, and then place into the top wing and secure the mounting bolts, washers and nuts for step seven of "Align the top wing." Now recheck the incidence.

With everything still at zero or 1 degree, mark—with a razorblade—both sides of the tops of the interplane struts where the covering is to be removed. Again, check the incidence, and then remove the wings without disturbing the cabane structure. Then tighten the cabane nuts completely. To provide an extra measure of reliability, I put a second nut (not supplied) on all eight bolts to ensure that the first nut will never vibrate loose. Then finish the steps of "Mounting the top wing" relating to gluing the interplane struts into the top wing.

• **Control-surface installation.** If you haven't done this, seal any loose covering on all the control surfaces and cut away the excess covering on the CA hinges. Be sure to use the wax paper that is noted between steps 15 and 16.

• **Engine mounting.** If your engine mounts are a bit warped, don't worry because once you've tightened everything up, the tension will true the parts. You will, however, have to use a blind nut for the lower left firewall engine-mount hole because the nut that is supplied interferes with the proper placement of the fuel tank. Also, add an extra nut to the four engine-mounting bolts so they won't vibrate loose.

• **Main landing gear.** In step two, I didn't glue the balsa gear cover into place. It had such a tight fit that I pressed it into place and secured it with stick-on covering. The supplied wheels, though, are too soft and spongy to be of any use. I substituted a spare set of 2½-inch wheels.

There are two dimples on each wheel pant, and one of them is about an ⅛ inch higher than the other. The idea is to have two location heights so the pants can be used on grass and a hard runway. This model's wheel pants each had the high dimple on the right side and low dimple on the left side. Once you've chosen the high or low position and cut out one of the wheel pants for this, place the wheels pants together (side by side) with the cutout on the inside, and trace the cutout onto the second wheel pant.

• **Control-linkage installation.** Knowing I fully intended to really wring this model out in the air, I considered using the stronger Du-Bro* servo arms, but I found they were not quite the right size for the model: their installation would have caused the aileron and elevator linkages to interfere with one another. I mention this only to save you time. The standard servo arms that came with my Airtronics* RD6000 radio worked perfectly during intense aerobatics.

In step three of the throttle-linkage connection, I set the RD6000 throttle stick and trim to the highest position and used the endpoint-adjustment feature to set the low-end position of the engine's carburetor barrel.

• **Rudder and elevator pushrods.** The following procedure worked well when

To prevent the nuts from vibrating loose, use four extra locknuts on the engine-mounting bolts. The plane balances perfectly with the Magnum .91, the Great Planes 2¾-inch spinner and the Master Airscrew 14x6 Scimitar Wood Series propeller.

installing the rudder and elevator pushrods. After taking care of the radio-compartment portion of the pushrod assembly, cut off the excess pushrod-guide length that is in the fuselage. Next, insert the pushrods into their respective guides; connect the pushrods to the servos with the servo arms in their neutral positions. Then assemble the tail-end portion of the pushrods by threading the 2x100mm threaded wires into the clevises (both ends are threaded), and then attach the clevises to the three control horns.

Determine the positions of the three control horns by placing the threaded wires in line with the pushrods that exit the rear of the fuselage and then placing the control horns on the control surfaces. Next, attach the control horns to the surfaces with the supplied hardware. Now center each control surface, and measure the length of excess pushrod that should be removed.

Cut off the excess pushrod where it exits the aft portion of the fuselage and thread the wires into the pushrods. To relieve the tension that might occur, I bent the rudder pushrod's threaded wire in toward the rudder to meet the control horn (see photo).

This procedure ensures that once it exits the fuselage, the pushrod will have a straight line to the control horn and there will not be any binding. Use a little petroleum jelly to lubricate the pushrod inside the pushrod guide.

• **Cowl and spinner**. To hold the cowl in place, I recommend that you use larger wood screws—with locking rings or washers—than those supplied. The ones supplied were too small and fell out of the cowl assembly when I first ran up the engine. The recommended spinner size is 2½ inches, but if you want a slight cosmetic enhancement, a 2¾-inch spinner more precisely matches the cowl ring.

After I had installed a Magnum* XLFS .91AR 4-stroke engine, a Master Airscrew* 14x6 Scimitar Wood Series propeller and a Great Planes* 2¾ inch spinner, with the battery pack and receiver mounted aft of the servos, the Ultimate balanced perfectly.

If you use a .46-size engine, you'll have to put the battery under the fuel tank.

The plane weighs 6 pounds, so for better flight performance, I recommend the larger engine—especially if you're good with throttle management.

FLIGHT PERFORMANCE

• TAKEOFF AND LANDING

Even on our rough grass field, the Ultimate was able to taxi without any problems. Owing to the coarseness of the surface and the lower wing's proximity to the ground, the Ultimate took 60 to 70 feet to become airborne. I applied throttle gradually and needed very little right rudder to keep the model tracking straight. (The Ultimate has a large rudder and a fair degree of right thrust built into the firewall; both help minimize the need for right rudder during takeoff.) With the Magnum .91 4-stroke at full power, the climb-out was speedy. To keep the nose pointed upward, I had to input "six beeps" of up-trim (beeps emitted by the digital trim function on the Airtronics RD6000).

When landing the Ultimate, keep the power at about ½ throttle during the downwind, and gradually reduce it on the base leg and final approach. For a nice smooth "glide slope," fly over the field threshold with ¼ throttle, and reduce it to ⅛ just prior to touchdown. The Ultimate 3-points quite well, at which time, you close the throttle; to avoid hitting the propeller on the ground, I recommend this type of landing.

Do not fly an extended downwind pattern or set up your downwind far away from you because if the engine quits, there is a good chance you won't make it back to the field (the Ultimate has a steep, dead-stick glide path).

• LOW-SPEED PERFORMANCE

With the .91 throttled to about ⅔, the Ultimate will actually hover on the prop. With the throttle set at ½ and some additional up-trim dialed in, it flies quite slowly. It stalls straight ahead, but it takes a bit of altitude to recover, so don't stall it close to the ground.

• HIGH-SPEED PERFORMANCE

At full throttle, the .91 and the Master Airscrew 14x6 prop haul the biplane around effortlessly. It will eat up a lot of sky, so when you do your passes, make sure that you have room to fly upwind and downwind. If you use the large engine and put the Ultimate into a dive, it would be wise to throttle back or you might exceed terminal velocity or experience some sort of structural failure when you pull out.

• AEROBATICS

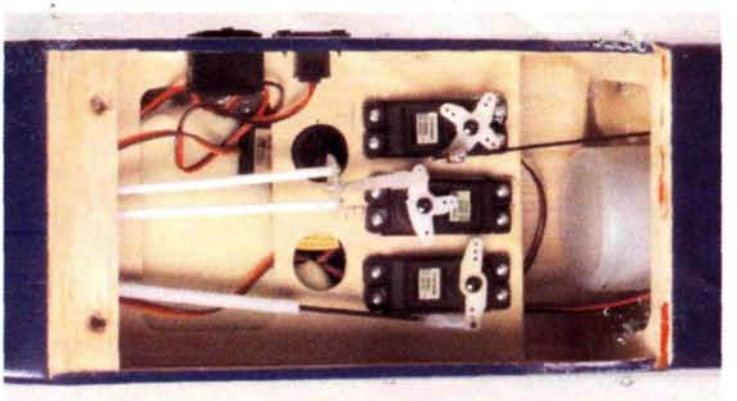
When set up with the recommended aerobatic control-surface throws, the Ultimate will do any maneuver that you are capable of. With the additional power of the .91 and a little extra control-surface throw dialed in, you can do some of the fancy 3D maneuvers that you see in magazines and videos. Throttle management is a must, though, especially in the dive portions of certain maneuvers. The Ultimate rolls beautifully and doesn't require much rudder input to keep a loop tracking straight. It will really "wind up" in a spin—and lose altitude quickly, so save some for the spin recovery.

This is a fast, smooth flying machine, and I recommend it for the modelers who range from advanced novice to expert.

IN THE END

If your construction time is limited and you're searching for an ARF biplane that has an easy wing-setup method, the Global Ultimate ARF is for you. Its prebuilt wings, interplane struts and preassembled and attached cabane struts mean that the tedious task of wing alignment has been completed for you at the factory. With the great covering job on the airframe, the painted cowl and the aforementioned features, you would be hard pressed to find a better prebuilt and covered model and one that goes together as quickly. Time is now on our side.

**The addresses of the companies mentioned are listed alphabetically in the Index of Manufacturers on page 142.* ✚



The spacious radio compartment has plenty of room for a standard radio. The battery and receiver are installed behind the servos.

MODEL AIRPLANE NEWS
READER'S
GALLERY

A ½-SCALE Demoiselle

by Jerry Nelson

Jorg Vogelsang of Hagen, Germany, is a very well-known giant scale modeler. He is recognized both for his master modeling talents and for the unusual subjects he selects. His efforts have included a ½-scale WW I fighter and a twin-turbine-powered WW II Messerschmitt 328. Jorg's most recent project is a ½-scale Santos DuMont 1908 Demoiselle 21 which, to the delight of everyone, he demonstrated at the annual Quarter Scale Aircraft Association fly-in in Las Vegas.

You might recognize this aircraft as being the one featured in the motion picture "Those Magnificent Men in their Flying Machines," but more impressive is that the Demoiselle 21 was Europe's first successful 3-axis-control (pitch, roll and yaw) aircraft. Its wing was rigged to twist or warp to provide roll (aileron) control, and the entire tail group was rigged to move as a single unit—no separate rudder or elevator surfaces. Jorg's model is a faithful reproduction of the full-size aircraft, and it features the same type of control setup.

Jorg Vogelsang poses with his ½-scale Demoiselle 21 at the recent QSAA rally in Las Vegas.

SPECIFICATIONS

Name: 1908 Demoiselle 21

Type: antique monoplane

Scale: 50 percent

Wingspan: 133 inches

Length: 168 inches

Engine: 277cc 4-stroke twin-cylinder (homemade)

Prop: 39x12 (wood)

Radio used: Graupner/JR* with Seiko 900 in./oz. torque servos

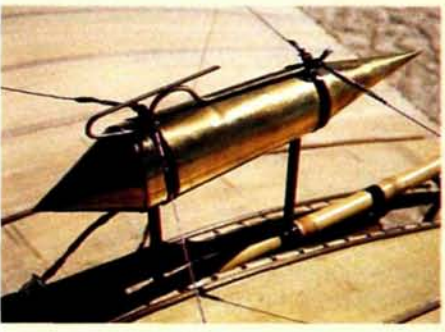
Comments: the model has 4-channel control functions, including wing-warping aileron control, and a one-piece articulated tail group for pitch and yaw control. Everything is scratch-built including the engine. Jorg's next project is a twin-turbine-powered Chance Vought Cutlass jet.

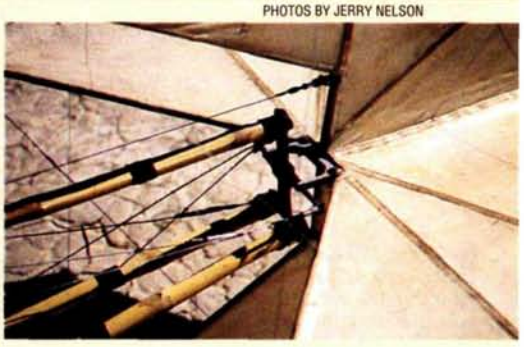
The model was also built using materials similar to those of the full-size Demoiselle; it has bamboo fuselage longerons wrapped with twine in several locations to prevent them from splitting. The highly undercambered wing ribs are made of spruce, and the varnished Dacron fabric is laced onto each rib. The large spoked wheels are homemade.

Jorg is an excellent machinist; he designs and builds the engines he uses to power his models; the Demoiselle powerplant is no exception. The 4-stroke, twin-cylinder, horizontally opposed engine has a 277cc displacement and utilizes a wet sump-oil

This is Jorg's homemade 277cc 4-stroke engine. It turns a 39x12 prop.

PHOTOS BY JERRY NELSON





Left: even the fuel tank is homemade. Center: the model's fabric is stitched onto the wing just as in the full-size aircraft. Right: the unique tail group is a solid structure attached by this swivel to the rest of the fuselage. Pitch and yaw control are very positive.

system (the oil is not mixed with the fuel). The engine is energized with a ProSpark* electronic ignition system and turns a 39x12 wooden prop at 3,200rpm.

The flight characteristics of this huge model are impressive. Flight speed at ⅓ throttle is approximately 25mph, and takeoff runs are only 20 feet long. At low-rpm cruise speed, the model appears to be very coordinated in the turns; there is hardly any engine noise. Despite its unusual tail-group control setup, and its having only a fixed tailskid, the model is very well behaved on the ground.

Of all the projects Jorg has brought to the QSAA meet, the beautifully crafted Demoiselle is my favorite.

**Addresses are listed alphabetically in the Index of Manufacturers on page 142.*

BUILD A CARDBOARD COMBAT

Not your ordinary paper airplane!

My son Aza and I had long wanted to make an RC model that looks like a conventional paper airplane, but neither of us knew of the other's interest. I had hesitated to design one because most paper airplanes are "flying wings," which usually require an electronic or mechanical mixer to control elevons that move up and down together to control pitch and in opposite directions to control roll. Even though affordable Hitec* transmitters with mixers are available, it seemed to run against the simplicity of the airplane to build it with elevons. One day, as I was sketching a paper plane on my shop blackboard, I realized that because the hypothetical rudder was nearly as long as each of the wing halves and was on the bottom of the wing, it would act as both an aileron and a rudder working in the same direction. I call it a "rudderon." A conventional rudder is too short to have much of an aileron effect and, if it is above the center of gravity, the moderate aileron effect it does have in producing roll works against its yawing effect.

A conventional flying wing uses elevons (Figure 1-A). To bank to the right, the right elevon goes up and the left elevon goes down (1-B). To pull up, the two elevons move up together (1-C).

With a rudderon system (1-D), to bank to the right, you move the rudderon over to the right (1-E). To pull up, the full-width elevator moves up (1-F).

The synergetic turning and banking effect of large, underslung rudders was known long before I was born, but it has seldom been used in models or full-size aircraft. In the WARP 9, it makes the airplane very easy to fly, even for beginners and gives the airplane a very tight turning radius.

As soon as I told Aza about this idea, he told me he had the same dream, and we immediately started building and flying planes we called "WARP 9s." With two of us building and test-flying, progress was rapid.

Starting with a good-flying paper airplane (on the left) we scaled it up into the WARP 9 on the right. We kept the balance point that worked on the paper model. This was our second WARP 9 prototype. Like the first one, it amazed us with its pleasant flight characteristics. All WARP 9s make automatically coordinated turns due to the rudderon configuration.

THE PAPER AIRPLANE GROWS UP

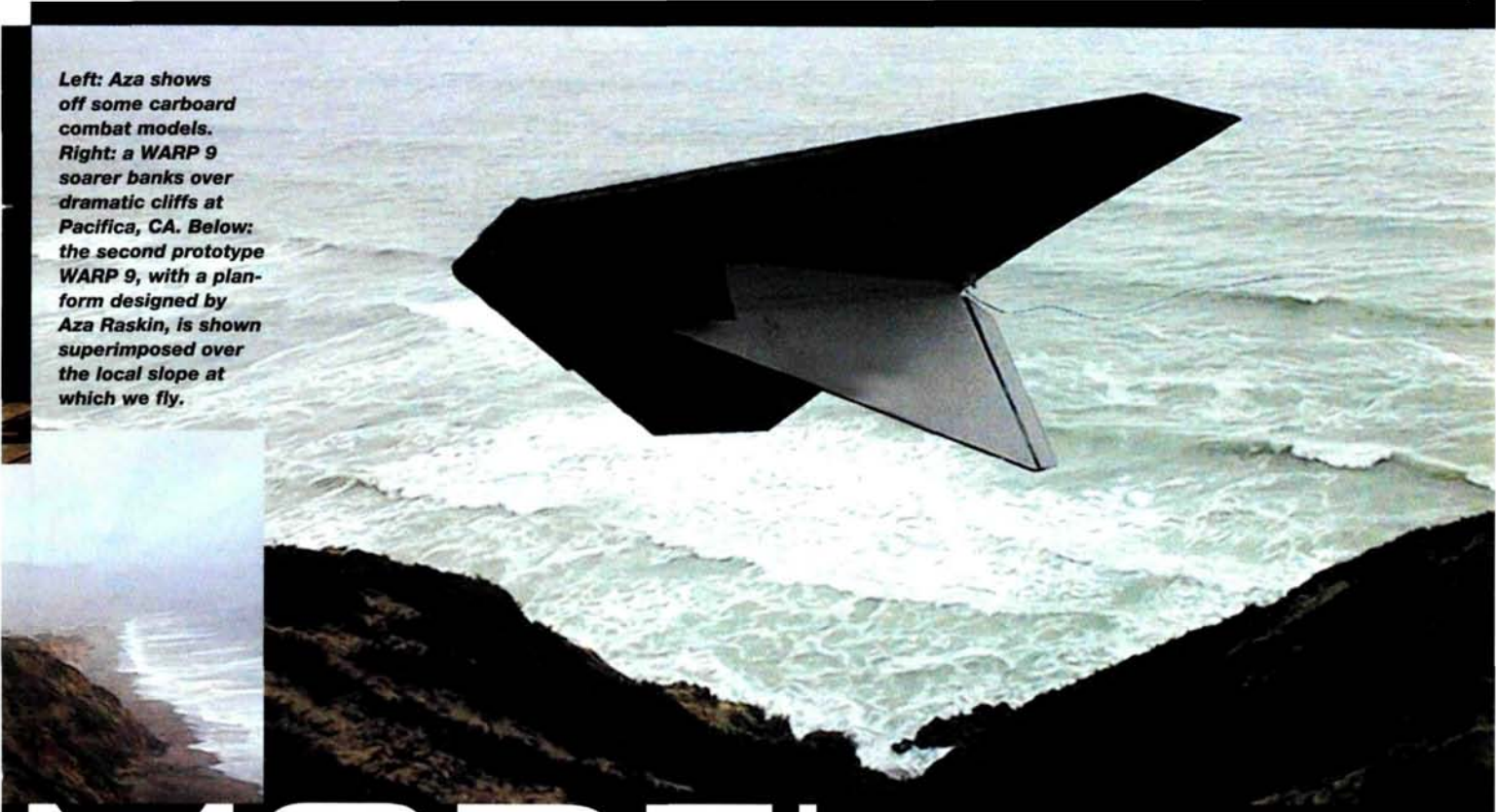
There are four parts to a WARP 9 airframe: the wing, the keel, the elevator and the rudderon. Typical spans and lengths range from 20 to 27 inches when using small (but not really tiny) RC gear.

After building a few WARP 9s (each one a little different, but all having the same pleasant flight characteristics), we learned that the design had some advantages we hadn't anticipated: the keel is easy to grasp for launching, and it provides a point to attach a hook for bungee launches; it also protects the radio equipment when landing.

Before you print out computer-drawn plans, add some graphics. There are colorful triangles on my plane, and Aza chose a dragon that we found on the Web. Talk about wowing them at the slope with your color scheme!

For inland flying, attach a rocket motor or a small glow engine to a WARP 9. On the slope, we learned that our soarer is nearly indestructible, which makes it ideal for contact combat. No fussy streamers; just knock the other guy out of the air—if you can.

Since WARP 9s are meant to look like paper airplanes, we build them out of one of our favorite modeling materials: corrugated cardboard. This stuff is just two flat sheets of paper glued together with a wiggly sheet of paper in between. Cardboard is surprisingly light, very inexpensive and strong and tough (which is the reason model planes usually come in cardboard boxes). Most shipping and packaging shops sell sheets of corrugated cardboard, but it is obviously less expensive to cannibalize a discarded cardboard box.



Left: Aza shows off some carboard combat models. Right: a WARP 9 soarer banks over dramatic cliffs at Pacifica, CA. Below: the second prototype WARP 9, with a plan-form designed by Aza Raskin, is shown superimposed over the local slope at which we fly.

MODEL

by Jef Raskin

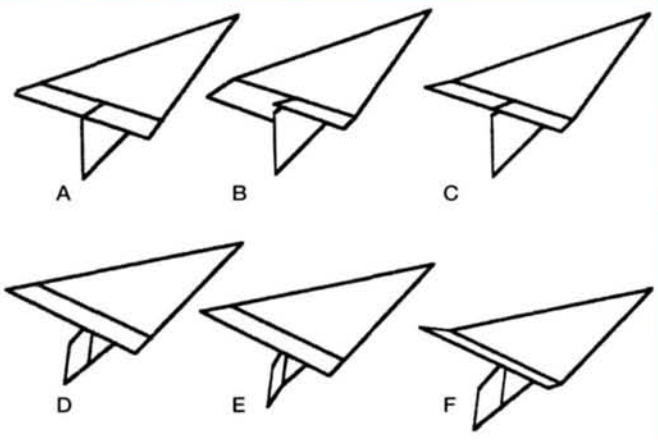


Figure 1. A conventional flyer with elevons vs. a flying wing that uses a "rudderon."

A. A conventional flying wing uses elevons.
B. To bank to the right, the right elevon goes up and the left elevon goes down.
C. To pull up, both elevons move together.
D. The rudderon system used on the WARP 9.
E. To bank to the right, move the rudderon over to the right.
F. To pull up, the full-width elevator moves up.

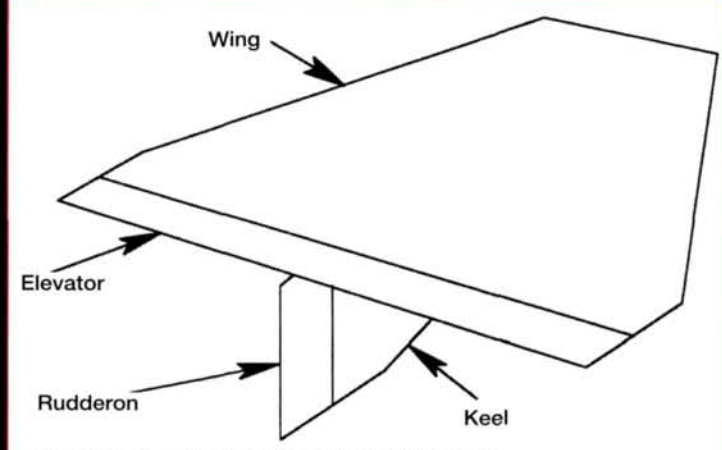


Figure 2. The four parts of a WARP 9 airframe.

Wherever you get your cardboard, try for the kind that is ⅛ inch (3mm) thick. In the trade it's called "B-flute." The "flutes" are the tube-like openings that run through inside the cardboard. With balsa, it is important to determine how the grain runs; similarly, with cardboard, we are careful about how the flutes run. Incidentally, A-flute is thicker and C-flute thinner than B (the thinnest cardboard I've seen is F-flute). You could build a WARP 9 out of foamboard, plastic corrugated material, or even balsa. We've found that foam-core board is relatively fragile, plastic is really too heavy and balsa too expensive, but this is a hobby, so your way is just as good as ours. B-flute cardboard comes in three weights. The best for flying is rated "125-pound test." We called around to local box makers and located cardboard in this weight, even though the heavier 175- and 200-pound-test cardboards are more common.

If you use cardboard with different surface materials on each side (such as a white finish on one side and brown craft paper on the other), or if you leave the finished model in a closed automobile on a hot day, the cardboard wing will take on a distinct spanwise curve—one reason why we call this model WARP 9. Though the plane theoretically would fly perfectly well with a curved wing, the elevator won't work with a curved hinge line. To "Star Trek" fans (which we are), "WARP 9" is the normal top speed of a Federation starship, and that's how fast these models look in the air—even though they are not, in fact, speedy flyers.

BUILDING A WARP 9

The shapes for a WARP 9 can be very simple and easy to lay out. If you use the cardboard itself as a hinge, as we do, there are only two parts to cut out! The easiest way is to use a computer drawing program to lay out the shapes, then cut out and glue them to the cardboard using Scotch 77 spray adhesive. We have the computer mark the balance point and the lines for hinging the elevator and rudderon. With a computer, adding fancy graphics is easy, and today's inexpensive ink-jet printers make it possible to do it all at home.

Assuming that you will choose cardboard, the best way to put a WARP 9 together is with a glue gun. Hot glue dries quickly, is easy to use and very tough, and its flexibility matches that of cardboard. It is also easy to unglue using a hot-air gun (the same kind as most of us use to tighten covering); you can easily fix any mistakes you might make. Typically, CA does not work well on cardboard, and most epoxies are too rigid. White glue is an acceptable, though slower drying, alternative.

The openings that run through the cardboard (the "flutes") should be oriented spanwise, from wingtip to wingtip. A steel straightedge and a sharp blade make quick work of the outline. A scroll saw is a good alternative.

Cut out the keel, with the flutes perpendicular to the wing, i.e., running up and down, not along the length of the keel.

BALANCING THE WARP 9 WITH THE RADIO GEAR

If you make your own planform for a WARP 9, the best way to find the proper balance point is to make a model of your design using stiff paper, balsa, or thin sheets of foam plastic. I use sheet foam from supermarket food trays. Keep the elevator the barest smidgen up, 1/32 inch or less, and add modeling clay to the nose until the model glides well. Notice where the model balances, then balance your WARP 9 at the same relative location. If you use the provided design, you'll see we've already marked the balance point.

Start by temporarily positioning the battery pack with masking tape so that the plane is just a bit tail-heavy, then position the receiver and servos until the balance is right. The control rods should not be so heavy as to materially affect the balance.

If your planform is an isosceles triangle, the balance point will be easy to find: it will be halfway between the front and the back!

The next step is to hinge the surfaces. My favorite method for making hinges is to cut the cardboard away except for one surface and to use the paper itself as a hinge (Figure 4). My paper hinges have lasted for years (I made my first one in the early 1970s), and if one does tear, a piece of clear packaging tape fixes it in a jiffy.

After you've made the elevator and rudderon hinges and are sure that they work freely, draw a centerline on the bottom of the wing. Place the wing upside-down on your work surface and, using a T-square or other right angle to make sure that the keel is perpendicular to the wing, glue the keel to the center of the wing.

Figure 3. The WARP 9 plans with balance and hinge lines shown.

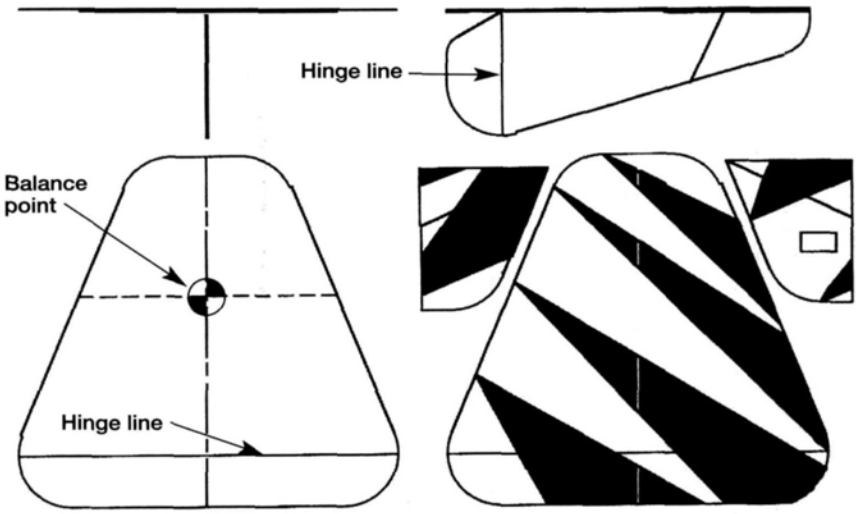
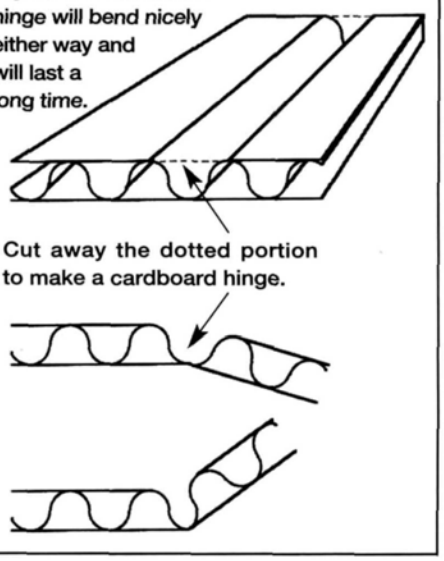


Figure 4. A cardboard hinge will bend nicely either way and will last a long time.



INSTALLING THE RADIO GEAR

You can either affix the radio gear to the underside of the wing using hot glue or double-sided tape, or put it inside the keel by building a cardboard box for it. My favorite method is to cut holes in the keel for the gear, and then attach a servo to each side of the keel just behind the receiver. None of this is critical so long as the WARP 9 balances at the right spot. The control rods should be dead-straight runs. I use old aluminum arrow shafts with short, 1/16-inch-diameter steel-wire ends hot-glued in—fast to build, stiff and light. Pieces of arrow shaft are available at archery shops that make custom arrows. I cut mounting positions for the nylon control horns into one layer of the cardboard, and then hot-glue the horns into place. Putting the horn on the side of the hinge that was cut away makes the surface less sensitive than if you glue it to the other side.

ON THE SLOPE

The WARP 9 is not a high-performance sailplane, nor is it a floater for those light-wind days. At our flying sites, it needs a good, straight-on breeze to stay aloft. But given some decent wind at the slope, it is a stable, easy-to-fly machine. It will hover like a kite and turn on an amazingly small radius. Because of the rudderon, inverted flight is nearly uncontrollable (we've done it, but it isn't fun). Loops are possible, but they require death-defying dives to get up enough speed. Aerobatics are not the WARP 9's "thing." But combat is another story ....

The WARP 9 loves combat. Its very high maneuverability and quick recovery into straight and level flight from almost any attitude makes it easy to recover from a hit. Keep the models in close because that makes contacting the enemy a lot easier. Because of the WARP 9's turning ability, you can fly several in a tiny area, which can be very exciting.

As I've said, with rudderon control, this model is not particularly aerobatic. But if you use elevons, it heats up a lot. With elevons, WARP 9 rolls require no preparation and are fast. With elevons, inverted flight is as easy for the plane as is upright flight (assuming you have the requisite trained thumbs). These models have low drag and pick up speed very quickly in a dive; because of their inefficient airfoils, they lose speed quickly in a climb, so plan accordingly.

Now, go ahead; build a pair of WARP 9s in a single evening, and fly "cardboard combat" the next day.

**The addresses of the manufacturers mentioned are listed alphabetically in the Index of Manufacturers on page 142.* ✦

by Vance Mosher

THE WESTLAND WYVERN S.4

The last of the prop-driven fighters

The wyvern was a mythical monster with the front legs of a dragon and the barbed tail of a snake and, of course, it was one mean creature! The Westland Wyvern was the last fixed-wing aircraft design from the Westland Aircraft Co. and was one of the last prop-driven fighters. It was a very large airplane that was about the same weight as a DC-3 but larger than—and twice as powerful as—a P-47 Thunderbolt. Its twin, contra-rotating props certainly gave it the same mean appearance as its fictional predecessor.

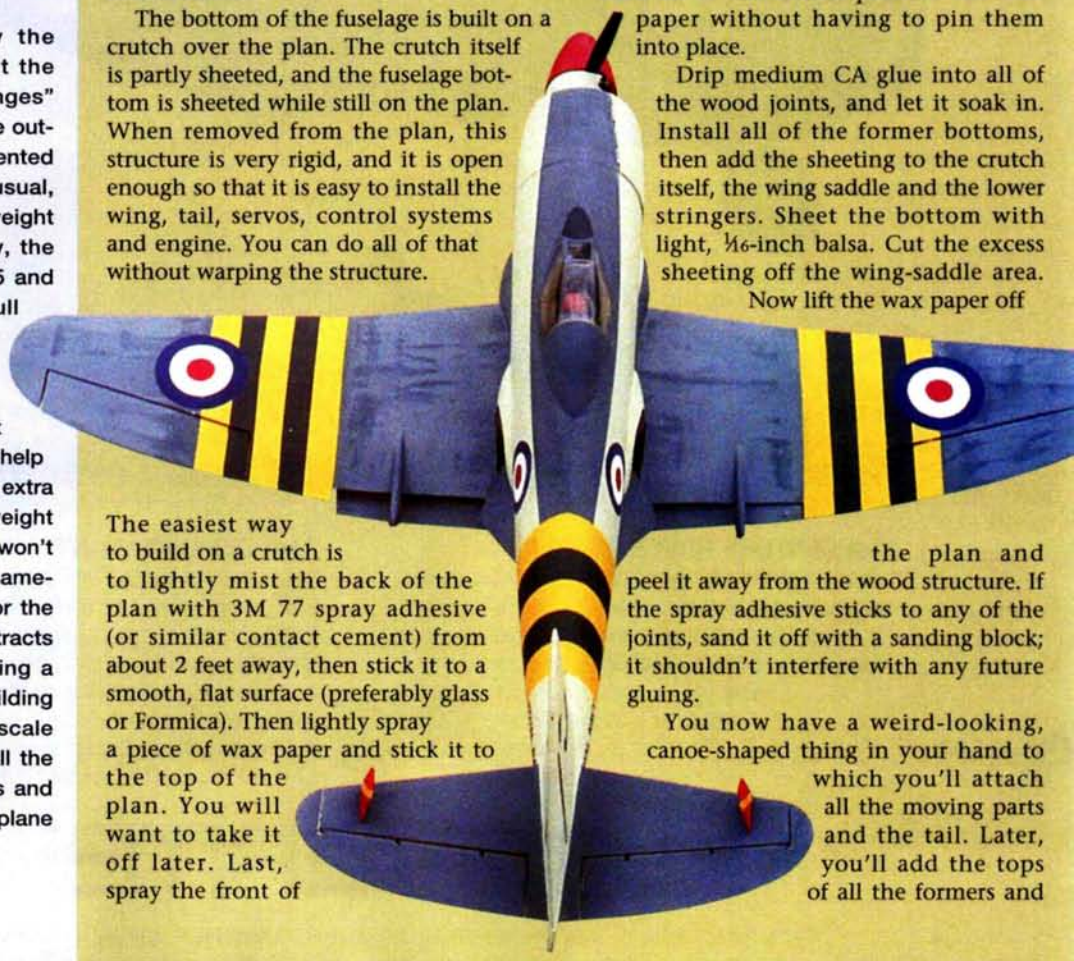
The Wyvern is a fairly complex aircraft in its all-out scale form. Don't worry about that, though; I designed this model to make everything as simple as possible. The only real requirement is that you want to build it.

There are ways to simplify the construction. You can leave out the flaps and retracts, use "easy hinges" and put all the control horns on the outside. In a simpler form than presented here, the airplane will still be unusual, will fly well and be lighter; and weight reduction is always good! Ideally, the airplane will be powered by a .15 and will weigh about 2 pounds. In full scale form, its weight should be kept to 2¼ pounds. Being heavier doesn't make the airplane harder to fly, but the power-to-weight ratio becomes marginal. It doesn't help to use a larger engine because the extra engine weight and the balance weight you would have to put in the tail won't improve performance (using the same-size wing). My recommendation for the sport flier is to forego the flaps, retracts and cockpit interior, thereby saving a couple of ounces and a lot of building time. If you do leave out all the scale stuff, you won't have to cut out all the weight-saving holes in the formers and ribs; that saves effort, too. The airplane is easy to land without any flaps.

CONSTRUCTION

The Wyvern fuselage and tail are built in "half-shell" construction. The wing is conventional.

The bottom of the fuselage is built on a crutch over the plan. The crutch itself is partly sheeted, and the fuselage bottom is sheeted while still on the plan. When removed from the plan, this structure is very rigid, and it is open enough so that it is easy to install the wing, tail, servos, control systems and engine. You can do all of that without warping the structure.



The easiest way to build on a crutch is to lightly mist the back of the plan with 3M 77 spray adhesive (or similar contact cement) from about 2 feet away, then stick it to a smooth, flat surface (preferably glass or Formica). Then lightly spray a piece of wax paper and stick it to the top of the plan. You will want to take it off later. Last, spray the front of the wax paper with a heavier coat of contact cement and let it dry for a few minutes. The final coat will allow you to stick all of the crutch parts to the wax paper without having to pin them into place.

Drip medium CA glue into all of the wood joints, and let it soak in. Install all of the former bottoms, then add the sheeting to the crutch itself, the wing saddle and the lower stringers. Sheet the bottom with light, 1/16-inch balsa. Cut the excess sheeting off the wing-saddle area.

Now lift the wax paper off the plan and peel it away from the wood structure. If the spray adhesive sticks to any of the joints, sand it off with a sanding block; it shouldn't interfere with any future gluing.

You now have a weird-looking, canoe-shaped thing in your hand to which you'll attach all the moving parts and the tail. Later, you'll add the tops of all the formers and

PHOTOS BY VANCE MOSHER

SPECIFICATIONS

Model: Westland Wyvern S.4

Type: 1/4 scale warbird

Wingspan: 36 in.

Length: 34 in.

Weight: 2 lb., 4 oz.

Wing area: 232 sq. in.

Wing loading: 22.36 oz./sq. ft.

Engine req'd: O.S. .15 2-stroke

Prop used: 8x6

Radio required: 4-channel (rudder, ailerons, elevator, throttle; flaps and retracts optional)

Comments: designed by Vance Mosher, the Westland Wyvern is an unusual scale project for someone interested in a smaller model. The model uses a half-shell construction for the fuselage and sheet-core construction for the tail surfaces. The wing is of conventional construction. The model is made with traditional balsa and ply.

the top sheeting. Two skin sheets should cover the whole top section. The model has a really long nose, so be sure to put the battery in the tail just behind the wing. Set the stabilizer upside-down on the bench; then, after installing the stabilizer saddles on the top of the crutch, place the inverted fuselage over the stab. Level the fuselage bottom from side to side before you glue the stab into place.

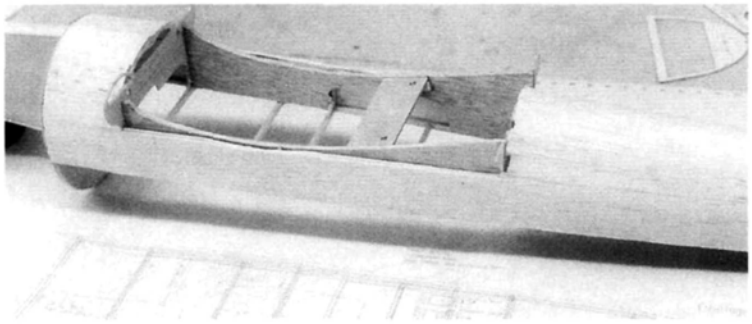
Attach all of the control pushrods to the tail, and install the engine hardware before you add the top sheeting to the fuselage. The rudder actuator is inside the tail cone, so the fin and rudder can be added later. Leave the fuselage open until you build the wing so that you'll be able to reach the wing-mounting plate and blind nuts. In this way, you can also make sure that the wing-mounted servos don't interfere with the fuselage-mounted servos.

WING

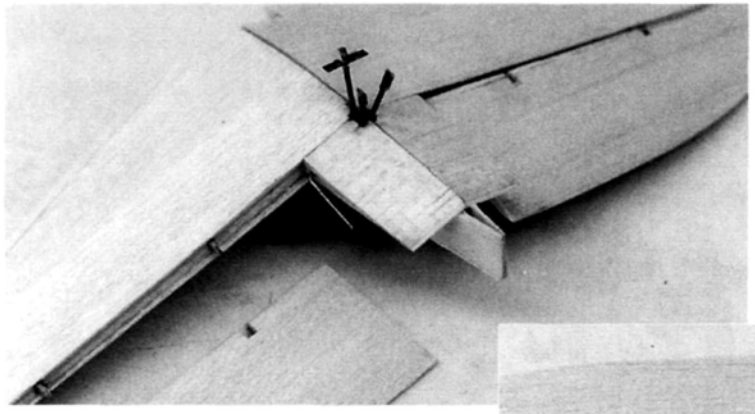
With the bottom spar placed flat on the plan, build the center section of the wing directly over it. Note the splices between the inner and outer spars; these save weight and help align the outer panels with the center section. Build the outer rib and spar assemblies separately, then splice them onto the center section at the correct dihedral angle.

Pick up the wing structure and sheet the bottom. Add all of the internal stuff, such as aileron pushrods and bellcranks, hold-down filler blocks and landing-gear plates. Cut open the wheel-well holes for the retracts (if used) in the bottom sheeting. Turn the partly sheeted wing right-side up and stick it back onto the plans. Put a 3/8-inch-square brace under the center rib TE. Put a 1/4-inch-square brace under the no. 6 rib at the wing dihedral joint. Lift the wingtip so there are 1 5/32 inches under the spar and 1 3/8 inches under the TE. This gives you a straight wing in the middle and the proper amount of washout at the wingtips. Sheet the top of the wing while it is still on the building board. Sheet the wing with fairly stiff 1/32-inch balsa.

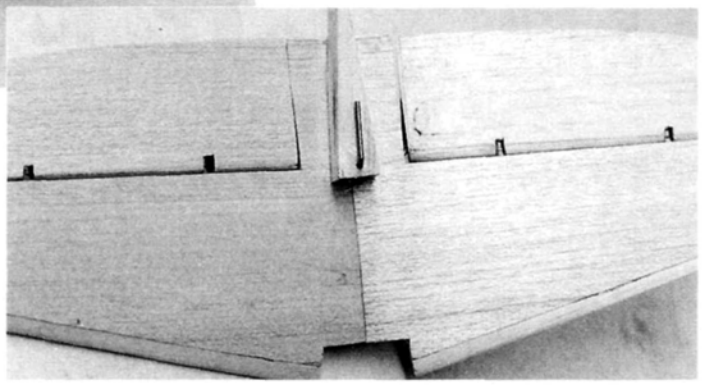
To make the scale aileron hinges, I used 1/4x1/2-inch pieces of easy hinges. To further simplify the model, you could use a straight LE on the aileron; change it if you like. I made the aileron bellcranks from small triangles of 1/32-inch ply with the corners rounded off. They pivot around large, cutoff T-pins pushed into and glued to an 1/8-inch balsa block. To actuate the ailerons, I used 1/32-inch wire pushrods supported by holes in the ribs for wire bracing. The aileron horns are attached just under the top skin of the aileron's LE. A piece of 1/32-inch music wire sticks out of the aileron pocket through the rear spar and is bent at a 90-degree angle for 1/4 inch. The wire is inserted into a short piece of small neoprene tubing that's glued with a drop of CA to the top of the aileron's LE. This setup works fine but is fussy to do because of space limitations. I had to thin the bottom of the top wing sheeting to clear the neoprene tube. A simpler way is to use a standard control horn mounted externally.



The fuselage is built using a half-shell construction. First, the bottom half is built directly over the plan, then it's removed from the board so the top half can be installed.



The tail surfaces are built with a sheet-core construction, and a fair amount of dihedral is added to the horizontal stab during construction.



Here's the completed stab. Note the rudder control wire and the scale-like, elevator-hinge arrangement. You can use simpler, conventional hinging if you prefer.

TAIL

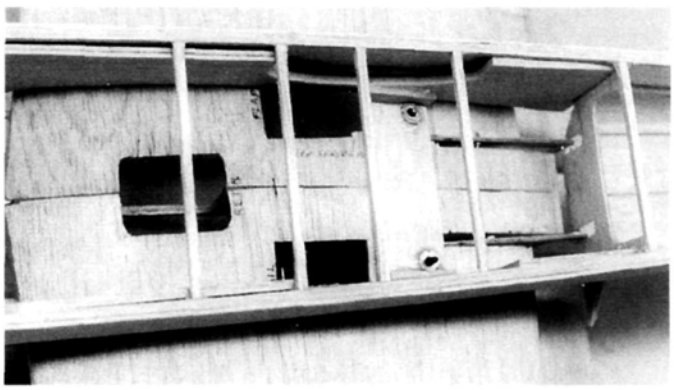
Because the surfaces are curved in all directions, I made the tail surfaces using sheet-core construction and built them flat over the plan. Once again, spray the wax paper and put it over the plan, then place the 1/32-inch core flat on the plan. The ribs are cut in halves lengthwise so the top half of each rib can be glued to the top of the core sheet. The sub leading edge is then added, as is the top half of the spar. After the spars have been contoured to match the rib profiles, the top of the surfaces is sheeted with 1/32-inch balsa. At this point, the structure is stiff enough to be picked up without warping. Prop up the stabilizer halves and fit and glue them together to form the dihedral shown on the plan. Then add the bottom rib halves and sheet the bottom surfaces. Add the LE last, and sand the whole thing to shape.

The fancy, scale-like, "buried" hinges shown on the plan are really nice, and they work very well; I recommend them for all scale stuff, suitably sized. They are actually easier to install than anything else except easy hinges. Cut little holes in the spars and shove the hinge supports into them. The 1/32-inch-i.d. plastic tubing shown for the scale hinges is from a "pull/pull" control-cable assembly, and it requires a 1/32-inch-diameter hinge wire. Be sure to bend the outer tip over for about an 1/8 inch so you can pull the hinge wire out of the surface.

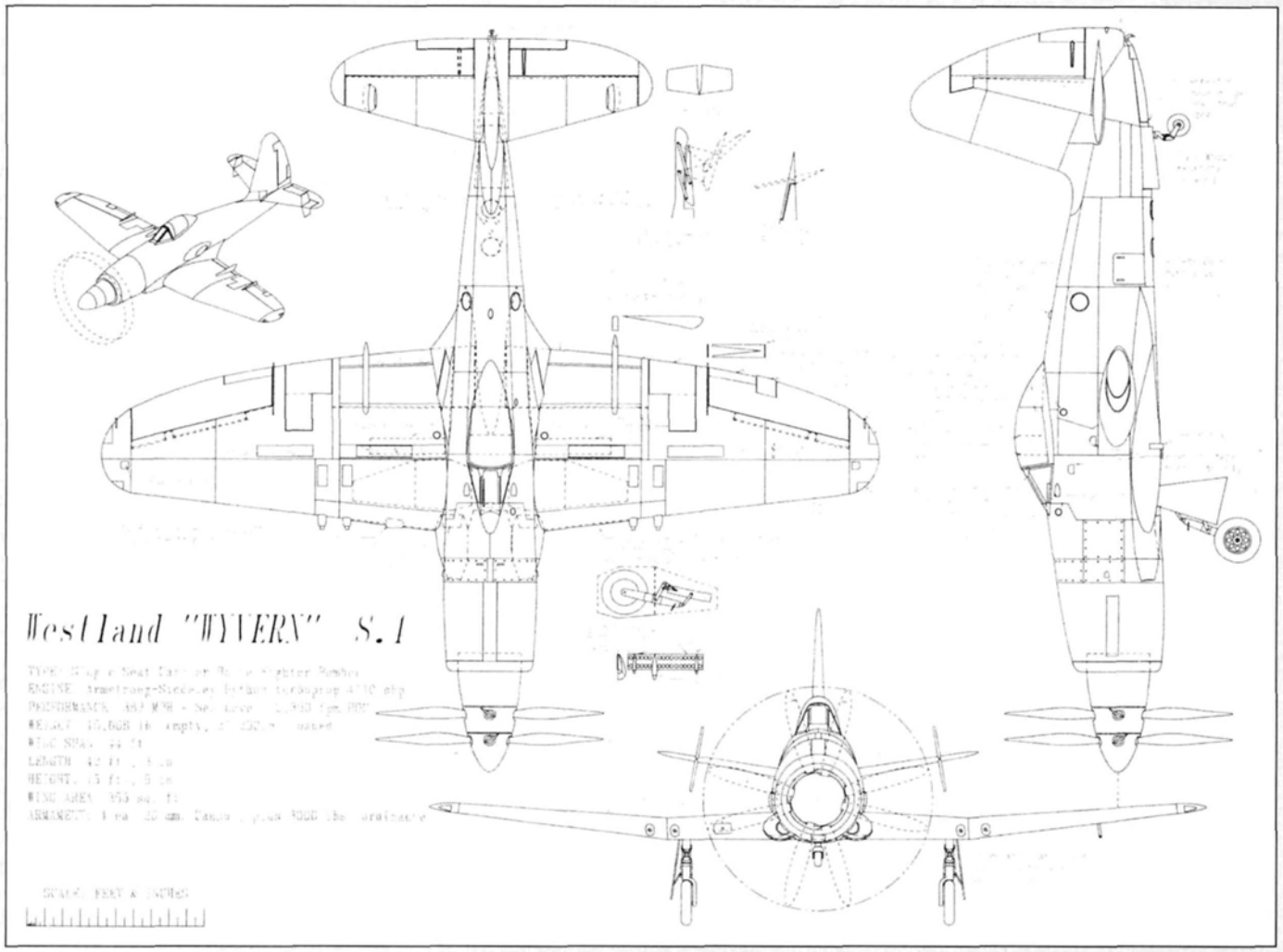
It's almost impossible to line up all the small sections of tubing if you install them one at a time, so install the tubing into the movable surfaces as one long piece with the hinge wire inserted in the tubing for stiffness; then pull out the wire, and notch the tubing later. After you've cut the notches, push the wire back into the movable surface and hang the hinge supports on the wire—one in each notch. Then push the hinge supports into the rear of the fixed surface until the movable surface is perfectly aligned. Put a drop of glue on each hinge support and pull out the hinge wire. You can reinstall the movable surface by lining up the hinges and pushing the wire back in at any time. It's really nice to be able to remove the control surfaces as needed for painting or adjustment. They also look just like real hinges.

POWERPLANT

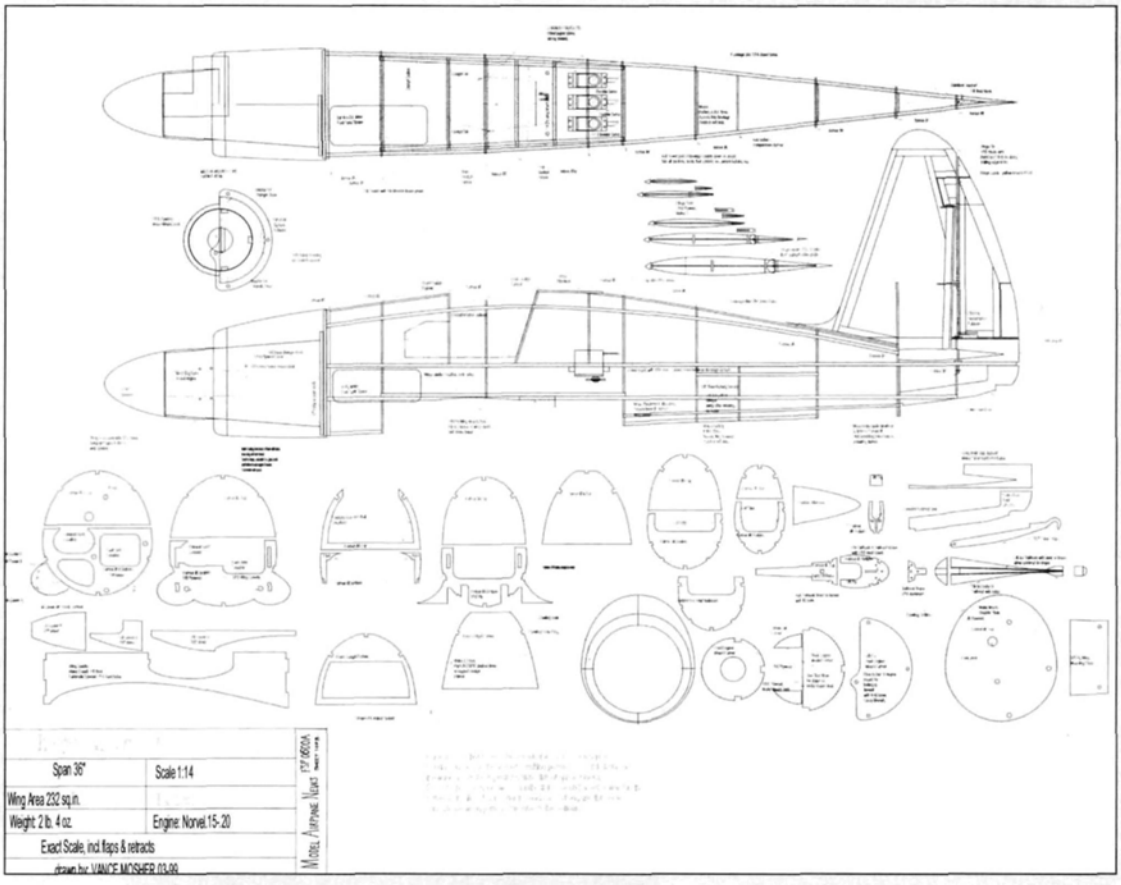
The new O.S.* .15 or the Norvel* .15 will both work with the Wyvern. Avoid heavier engines. This airplane is already nose-heavy, and lead doesn't fly well. The entire power system is mounted in a conical structure that is glued to the firewall; that makes installation easy. I used a 2-ounce tank, which gave 7 or 8 minutes of flight time. Again, you don't need more weight in the nose. After the engine mount has been glued to the firewall, hollow out a couple of styrene foam blocks to fit around it. The blocks should be the same length as the distance from the firewall to the back of the nose ring. Glue the balsa nose ring to the front of the blocks, centered on the engine, then sand the foam to blend in with the nose ring and the front of the fuselage. Cover the shaped foam with a couple of layers of 2-ounce glass cloth using epoxy resin. Sand smooth and cut a hatch out of the side of the cowl around the engine and back to the firewall. There will be a short section behind the muffler hole where the bottom seam goes. The top seam should be on the color-break line. Hollow out the hatch to about 3/16-inch thickness, cover the inside with a layer of glass cloth, and hinge it at the top edge with a couple of pinned hinges recessed into the foam to make the joint thin. Sand the bottom edge of the main cowl to the same thickness as the hatch. I use a snap fastener at the bottom of the hatch to hold it closed; this is a piece of canopy plastic formed into a question-mark shape. The straight tail section is glued to the inside of the hatch, and the bump on the other end points downward and fits over a piece of 1/8-inch-square wood that's rounded on the open side and glued to the bottom inside of the cowl. This simple latch allows you to open and close the hatch for fueling without



Here, you can see the wing-attachment blind nuts and mounting plate. Dowels secure the front of the wing to the forward fuselage bulkhead.



FSP 0600A
Westland Wyvern S.4
Designed by Vance Mosher, the Westland Wyvern is an unusual scale project for someone interested in a smaller model. The model uses a half-shell construction for the fuselage and sheet-core construction for the tail surfaces. The wing is of conventional construction. The model is made with traditional balsa and ply. The plan set includes scale 3-view drawings.
WS: 36 in.; L: 34 in.; engine: .15 2-stroke; 3 sheets; LD 3. $24.95



TO ORDER THE FULL-SIZE PLAN, SEE PAGE 126.

FLIGHT PERFORMANCE

The Westland Wyvern is a much smaller airplane than I am used to flying, so I was a bit concerned that it might be squirrelly. It isn't. The widely spaced landing gear and huge fin make takeoffs and landings very orderly. There is no particular yaw problem on takeoff, nor is there an abrupt leap into the air. It doesn't want to nose over into the grass during the takeoff run, either.

Flight characteristics are equally smooth. The airplane tracks well in all axes. Tiny little wingtips just aren't as stall-resistant as larger ones, so the stall strips on the inner LE should be kept sharp. At 36 ounces, this airplane is heavy. An ideal weight would be about 32 ounces—obtainable if you do not add the flaps and retractable landing gear. Stalls are not abrupt, even at the heavy weight, but lightening the model would make it much more spin-proof.

One big surprise was flap operation. When I first used the flaps, I had the Wyvern balanced nose-heavy, which seemed like a good idea on a new airplane. Fortunately, the model was up about 100 feet when the flaps were lowered; flap extension pointed the model's nose straight down! Adding about an ounce of lead to the aft fuselage after landing allowed the Wyvern to be controlled with the flaps down, but it isn't pleasant to handle in that way. Fortunately, you don't need the flaps to land the airplane, as it has very good landing characteristics with the flaps up, so I recommend leaving them off. They sure do look cool, though ....

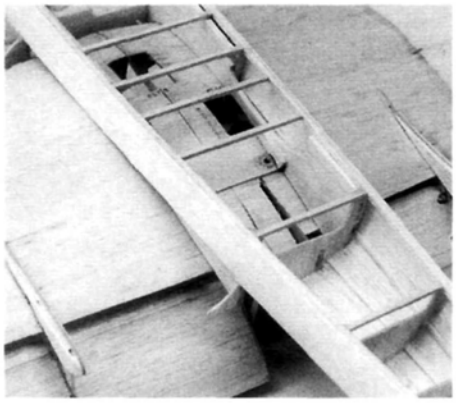
One other thing is important: a scale model needs an engine that doesn't lose a lot of power at less than peak rpm. The new Norvel .15 looks good; a new O.S. .15 would work fine at a lighter weight. The Wyvern just barely flew with a new O.S. .10. (That was where all the stall-testing took place.) If possible, run an 8x6 prop at about 12,500rpm, and you'll be OK.

any tools. You just pull the hatch open and push it closed. To make your latch fit properly, you can recess the foam behind the ⅛-inch square.

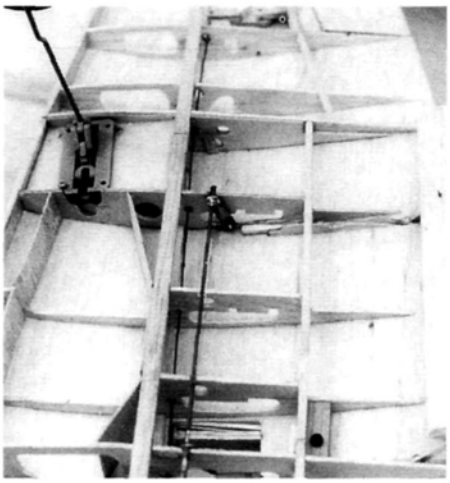
MECHANICS

I use microservos and Robart* micro retractable landing gear in this airplane. I am delighted with the little Hitec* servos I used. The retracts have small bumps protruding from the mechanism that stick out into the mounting rails, so installing them is a tedious cut-and-fit operation. To save weight and conserve space within the model, use a mini receiver and a 250mAh battery if you can.

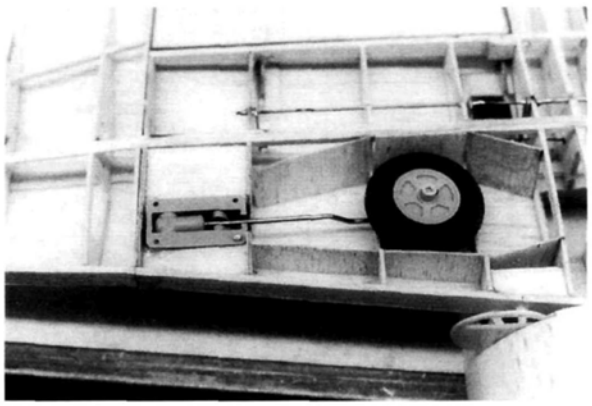
Note the servo locations shown on the plan. Do not move the servos any farther forward. Pushrods are all made from 1/32-inch wire, and their lengths are adjustable by using two pieces of overlapping wire and securing them together (at the correct length) with a 1/16-inch wheel collar. Be sure the front piece of wire is short enough to make the wheel collar visible in the wing opening.



The flap arrangement is scale and rather unusual. To save weight and effort, you can elect not to build flaps into the wing; the model flies fine without them.



Here's a view of the flap drive mechanism; the flaps lower and extend simultaneously.



I used Robart mini retracts; here, they have been installed in the wing.

The engine cowl is hinged; it swings out of the way to allow access to the powerplant. Note that the fuel tank is mounted in front of the firewall. It's very easy to get to.

FINISHING

The entire airplane is covered with damp silkspan doped on with nitrate dope (Coverite* Primex or Sig* nitrate dope). Any other finishing method would probably be too heavy. Give the entire surface a couple of coats of thinned dope before putting on the silkspan. Don't use dripping-wet silkspan on the thin balsa, even after it has been doped; this will warp the wood badly! Use about three coats of dope over the silkspan, sand lightly and then spray the airplane with Cheveron* Perfect Paint. I used Extra Dark Sea Gray on top and Duck Egg Blue on the sides and bottom. The stripes and insignias are Floquil* model railroad paint (Dark Blue, Reefer White, Grimy Black, Reefer Yellow and Caboose Red). These colors are a perfect match for those used on the full-size Wyvern. They are all fuelproof, too, but since they are urethanes, give them a week to cure.

You can use a P-51D Mustang canopy instead of forming your own. My pilot was homemade out of styrene foam. The spinner was made from light balsa as described in my article, "How to Custom-Build a Scale Spinner" (July 1999 issue of *Model Airplane News*). Be sure all the controls work smoothly and in the right directions.

Also, be certain to balance the airplane as shown on the plan—right on the main spar! After that, go fly it. Take some pictures, too. Not everyone has a Wyvern. Good luck!

*Addresses are listed alphabetically in the Index of Manufacturers on page 142. ✦

Enya R1.55-4C 4-stroke

I've always thought of Enya as the Japanese counterpart to SuperTigre. Like the Italian engines, Enya's engines always featured fantastic metallurgy and seemed to last forever. This also meant—as with the SuperTigre—that Enyas needed a bit of time to break in, but when this procedure was accomplished, you were rewarded with a powerhouse for many years to come. This is true of Enyas and SuperTigres to this day.

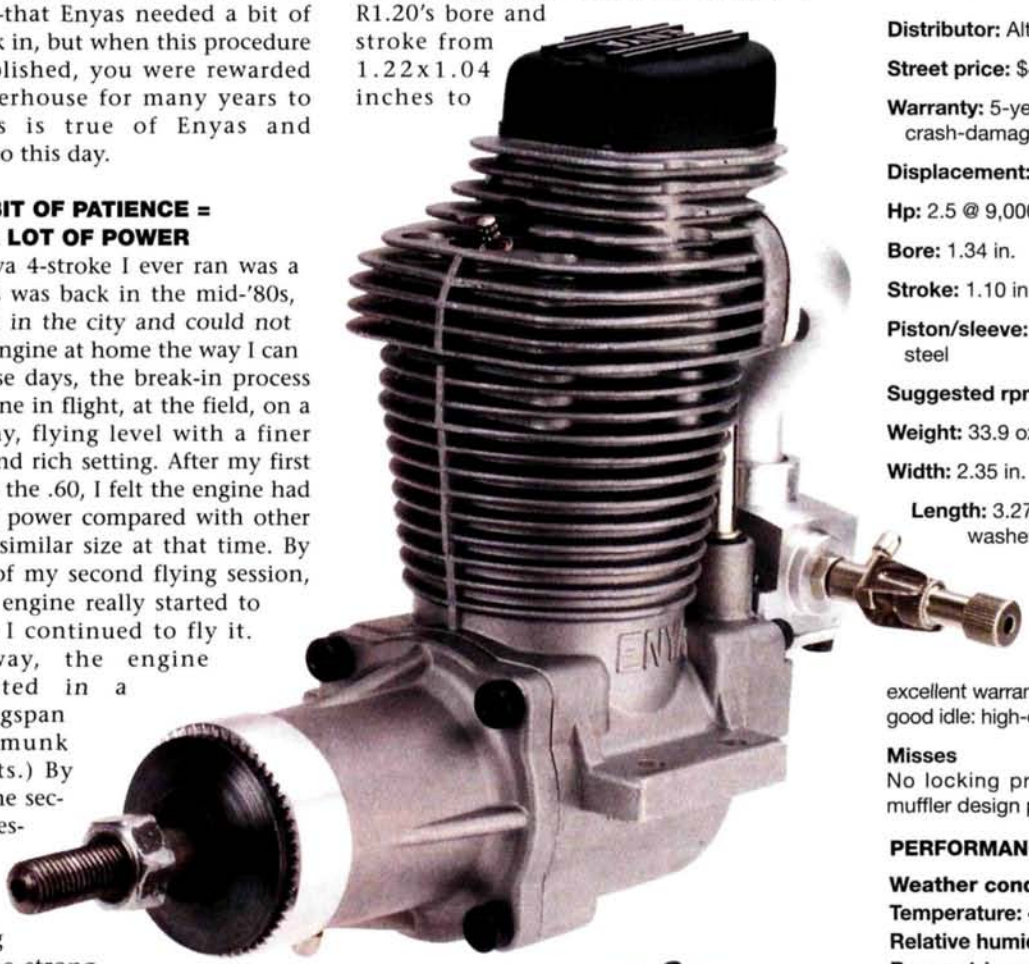
A BIT OF PATIENCE = A LOT OF POWER

The first Enya 4-stroke I ever ran was a .60 size; this was back in the mid-'80s, when I lived in the city and could not break in an engine at home the way I can now. In those days, the break-in process had to be done in flight, at the field, on a cool, dry day, flying level with a finer pitch prop and rich setting. After my first day out with the .60, I felt the engine had only average power compared with other 4-strokes of similar size at that time. By the middle of my second flying session, though, the engine really started to come on as I continued to fly it. (By the way, the engine was mounted in a 56-inch-wingspan Super Chipmunk with retracts.) By the end of the second flying session, I realized that the Enya was turning out to be the strongest in its class by a good margin. I mention this because some modelers today seem to be missing out on some very high-quality, long-lasting engines, simply because they don't run perfectly right out of the box. Now, I know I'm a little "over the top" when it comes to engines; to me, breaking in an engine and watching its power increase is like raising a child—well, sort of, I guess. But even if you're the type of modeler who considers an engine to be only a necessary means of getting your model to altitude, a little time spent breaking it in will reward you with years of power and reliability—trust me on this one.

A GREAT ENGINE MADE LARGER

The R1.55 is based on Enya's proven R1.20, a design that has been around for many years but is still very powerful, even by today's standards. The greater displacement has been achieved by increasing the R1.20's bore and stroke from 1.22x1.04 inches to 1.34x1.10 inches. Like the R1.20, the R1.55 has the same air-bleed carburetor with unique sliding barrel-choke mechanism.

I do prefer twin-needle carbs because mixture is regulated by



Enya includes long choke-extension rods (right) and main needle-valve extension rods—very much appreciated in scale cowl installations.

SPECIFICATIONS

Engine: R1.55-4C

Manufacturer: *Enya Metal Products Co. Ltd. Japan*

Distributor: Altech Marketing

Street price: $425

Warranty: 5-year limited w/1-year crash-damage protection

Displacement: 1.55ci

Hp: 2.5 @ 9,000rpm

Bore: 1.34 in.

Stroke: 1.10 in.

Piston/sleeve: Aluminum/hardened steel

Suggested rpm range: 2,000 to 10,500

Weight: 33.9 oz.

Width: 2.35 in.

Length: 3.27 in. (rear hole to thrust washer)

Shaft diameter: 8mm

Hits

Excellent power, excellent metallurgy, excellent warranty, good throttle transition, good idle: high-quality tools included!

Misses

No locking prop nut: "flow-through" muffler design provides little silencing.

PERFORMANCE

Weather conditions
Temperature: 47°
Relative humidity: 46%
Barometric pressure: 29.82

	Rpm
APC 14x10	9,680
APC 15x8	9,540
APC 15x10	8,970
APC 16x8	8,910
APC 16x10	8,140
APC 16.5x12	7,110
APC 17x8N*	8,340
APC 17x10N	7,420
Menz Ultra 18x10	6,630

All tests were done using 15 percent nitro Wildcat Premium Extra fuel with 18 percent lubricant (synthetic/castor 80/20 mix) and an O.S. "F" glow plug.

*Narrow

Astro Flight News

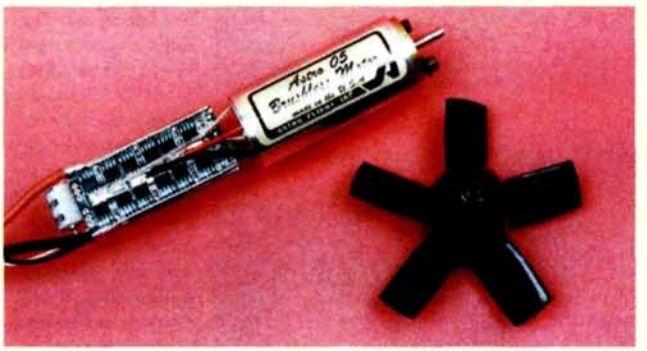
Astro Flight Inc. Introduces five new and exciting products for the electric flyer: The new Mighty Micro 010 Brushless Motor for park flyers, a new Ducted Fan Brushless 05 Motor for the Kyosho T-33, FAI-035 and FAI-05 Planetary Motors for Sailplanes and two new surface mount digital speed controls.

The Mighty Micro is here!

Our new Mighty Micro Brushless 010 Motor #801 has arrived. The motor is one inch in diameter and one inch long and weighs only 35 grams with sensorless control. It spins an APC 6x2.8 prop at 9800 RPM while drawing only 2.5 amps from a six cell 350 mahr Nicad pack. Now you can fly for 5 minutes on Nicads, 10 minutes on Hydrides and one hour on lithium cells. The tiny On-Off Brushless control has Brakes and BEC. This system will work with 5 to 8 cell batteries. Perfect for models up to 10 oz.

New Ducted Fan 05 Motor!

Our new 4 turn Brushless 05 Ducted Fan Motor #805F with 12 FET controller is specially designed to add Afterburner performance to the Kyosho T-33 and WE-Mo-Tek 480 ducted fan units. Run the T-33 fan on 8 or 9 Nicads or 10 Sanyo 3000 mahr Hydrides. The motor draws only 19 amps for 10 minute flights on Hydrides.

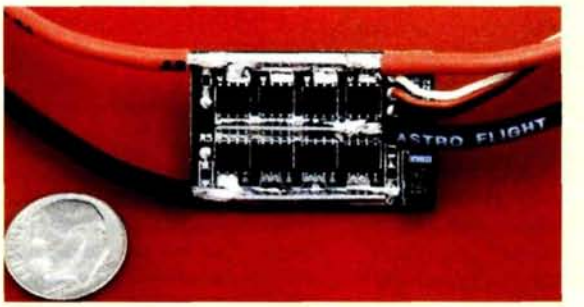


FAI-035 with Planetary Gearbox

Our new 4.4:1 planetary gear box is now available for all Astro Cobalt 035, 05 and 15 motors. The FAI-035 with planetary gear box is perfect for 7 cell competition sailplanes. The FAI-05 with planetary gear box, shown here, is perfect for 10 cell sailplanes.

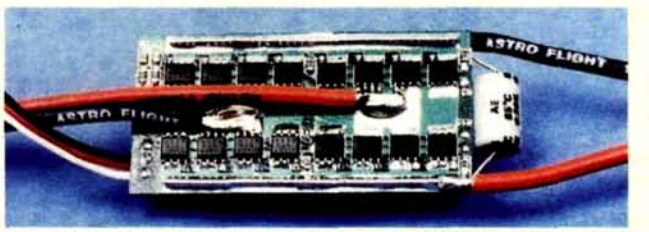
New Astro 215D Airplane Control

The new Astro 215D Speed control uses new surface mount technology for minimum size and maximum performance. The tiny 215D weighs only 8 grams and has Brakes and BEC. It handles up to 30 amps and 10 cells. Perfect for Astro Cobalt 035, 05 and 15 motors.

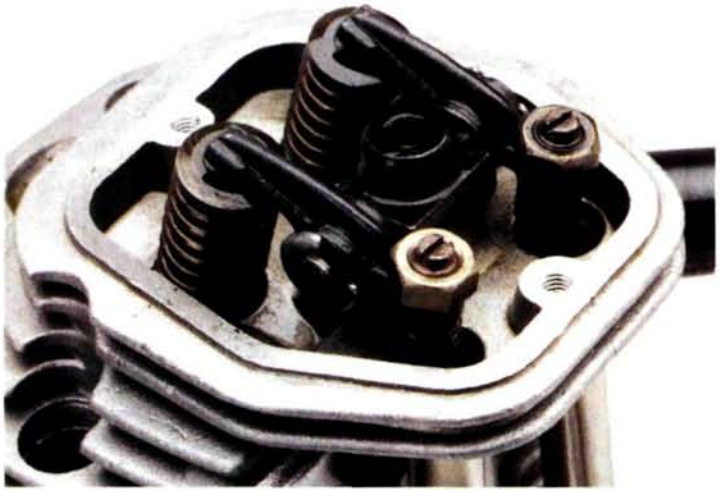


New 208D Reversing Control

The new 208D Reversing Control is designed for scale boats. It's 16 FET H-Bridge circuit gives you full power forward and reverse. The 208D weighs 1 oz and can handle 25 amps at 6 to 12 volts. It has a 2 amp BEC and a electronic current limit of 28 amps, so no fuses are needed. It was designed for tug boats and works great with 150 pound robots and electric powered blimps.



Astro Flight Inc. 13311 Beach Ave. Marina Del Rey, CA 90292
Phone (310) 821-6242 Fax (310) 822-6637 Web Site http://www.astroflight.com



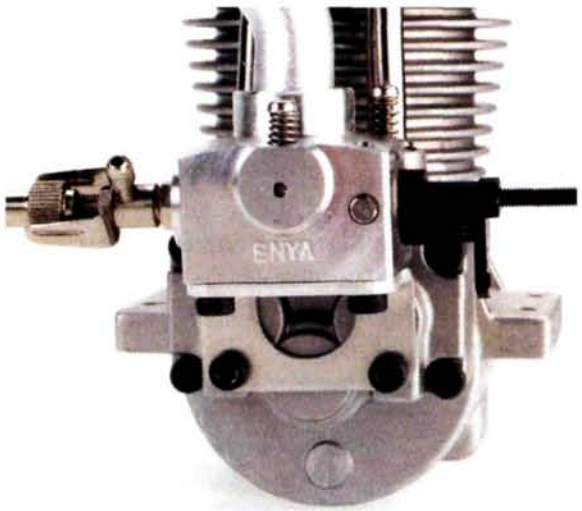
By removing a single valve cover, you can easily adjust the valve clearance whenever you need to while the engine is still mounted in your plane.

metering the fuel at all throttle settings, and this yields a very precise mixture in all rpm ranges. An air bleed, on the other hand, is leaned at a lower throttle setting by—as its name implies—bleeding air through the carb body at partial throttle setting. This bleeding of the air can give less fuel draw at certain mid-range throttle settings than that of a two-needle type. At full throttle settings, however, the fuel draw with an air-bleed type is pretty much on a par with that of a two-needle type. I have experienced momentary mid-throttle sagging during high-G maneuvers with some 4-strokes using air-bleed carbs. However, I've never had this problem with the R1.20, and I've had two of them in various aerobatic designs. I'm sure the larger-displacement R1.55 will perform at least as well as the 1.20 since it has the same setup. At any rate, after this test, I'll be putting the 1.55 in a 73-inch-wingspan Breitling CAP 232, and we'll see for sure.

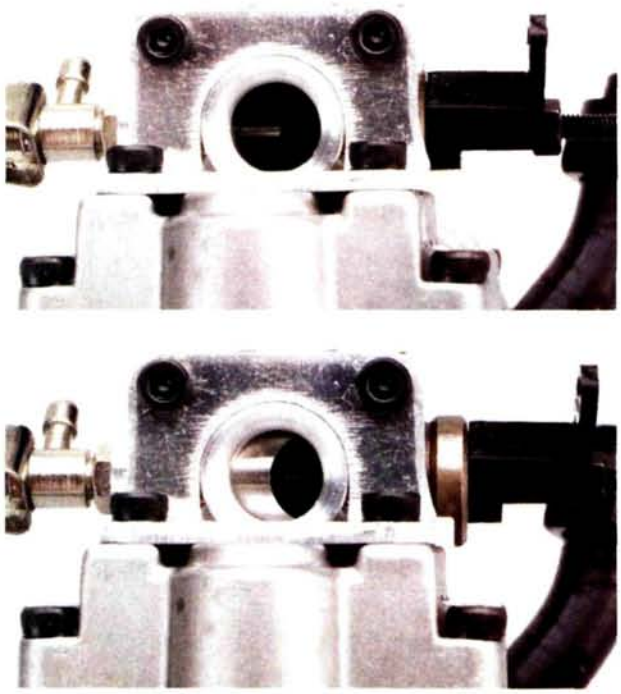
PERFORMANCE

After running a 14x8 APC prop for seven 12-ounce tanks of fuel for break-in—a little over an hour's running time—I started to take some readings with my TNC tachometer using prop sizes more suitable for flying. After I had taken readings on all nine props, I returned to the first prop, an APC 15x8, and noticed the engine had gained almost 200rpm since I first ran it. It seemed that the ring had seated on the sleeve surface just a bit more, so just to be sure, I took another set of readings for all the props.

Left: Enya includes a high-quality set of tools with this and other 4-stroke engines. I commend them for it, as it is a practice that seems to be disappearing from other manufacturers. Even glow-plug extension wiring is included; owing to this particular engine's plug placement, I recommend using it. Right: a "miss" with the R1.55 is the stock "flow-through" muffler. The noise produced by this engine is commensurate with its high power. On the left is an optional muffler from Altech; it is many times the size of the stock unit, and with its internal baffles, the optional unit should silence more efficiently. I will use it when I mount the R1.55 for an upcoming CAP 232 article and will measure the difference in noise level with a dB meter.



The hole in the center of the carburetor body bleeds air into the mixture at partial throttle settings. When the throttle is at full, the air-bleed hole is blocked off by the throttle barrel. The screw above the air-bleed hole adjusts the size of the hole and the amount of air that is bled. The more the hole is opened, the leaner the low-end mixture becomes. I never once had to touch this adjustment during the entire test.



Two photos that illustrate the R1.55's unique barrel-choking mechanism—a proven design carried over from the R1.20. The top photo shows the non-choked position; below, the black extension arm has been pulled and the Venturi is partially blocked (choked) off by the right-hand throttle-barrel movement. This system works well, but take care not to over-choke. During warm weather, this engine needs little, if any, choking when an electric starter is used at low-throttle setting.

(Safety note: as the R1.55 is not equipped with a two-piece locking prop nut, it is important to tighten the single-piece prop nut securely with a 13mm automotive box wrench—*not* a 4-way wrench!)

Supercharged types of engine (such as the YS) aside, the R1.55 holds its own—and then some—on certain props versus any available 4-stroke of similar displacement. The Enya did particularly well—close to 9,000rpm—on two props that are most commonly used in flight for aerobatic and scale-model purposes: an APC 15x10 and a 16x8.

In the past, I used Perry's oscillating pump on Enya's R1.20 and on other 4-strokes with outstanding results. Mixture remains constant throughout the up and down legs of maneuvers and ensures positive feed even during the highest "G" encountered in aerobatics. The pump is mounted on the front housing, opposite the cylinder. I will incorporate this unit in my upcoming CAP 232 article.

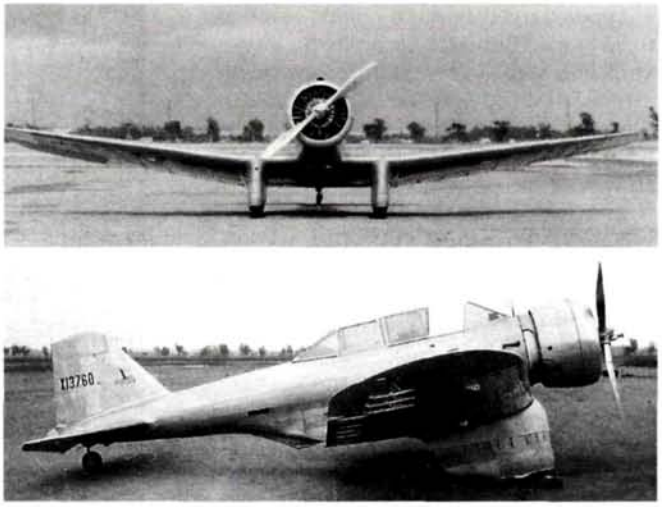
Who knows? With yet a bit more running time and further ring/sleeve seating, the 1.55 might well hit the 9,000 mark on either of these props; it's quite powerful, to say the least. On any of these props, the engine—after break-in, of course—would reliably idle at 2,200rpm and even at 2,100rpm on some of the larger sizes. Vibration levels were more than acceptable, and the air-bleed carb provided good throttle response at all times. During the very first two or three startups, the engine was a bit cranky and needed the application of an electric starter. After the ring started to seat on the sleeve, however, the engine started easily after slight choking by flipping the prop backward against compression. These big-bore, single 4-strokes can kick back hard, so use a chicken stick and don't forget the goggles.

I had many years of trouble-free service from both of my R1.20s, and I expect the same from this bigger-bore version. We'll revisit the R1.55 and the available muffler option at the field after it has been mounted in my CAP. See you there. ✦

The importance of materials, structures and stresses

Design and Build Light, Sturdy Airframes

by Andy Lennon



The single-motor, Northrop long-range light bomber illustrates the principles of stressed-skin design. This aircraft was able to carry a load of just under 95 percent of its empty weight.

Powerful engines, efficient propellers and precise radio control with high-torque servos enable today's model planes to fly at high speeds and to perform maneuvers that create structural stresses caused by centrifugal force—up to 10 times the model's own weight! Rugged yet light structures are essential.

Engines of .40 to .46cid seem to be the most popular sizes used to power models that have 500 to 800 square inches of wing area. An analysis of the weights of these aircraft discloses that the powerplant, RC equipment and landing gear constitute from 45 to 55 percent of a model's fueled weight; the larger the model, the lower that percentage. After they've been selected, these are "fixed" weights, and the designer has little leeway for change. The remaining components—fuselage, wings and tail surfaces—also total 45 to 55 percent of a model's gross weight, but their weights can be adjusted. It is easy to provide adequate strength by using larger pieces or heavier materials. It is not so easy to design a rugged but light structure.

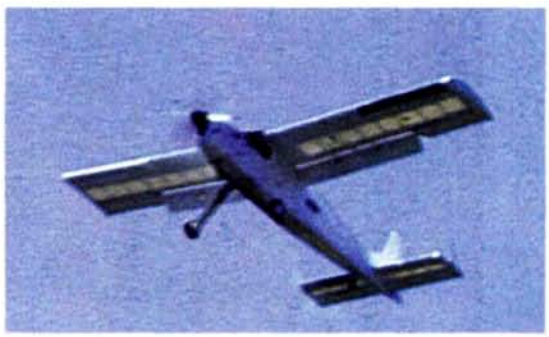
In 1937, the British Air Ministry purchased an American aircraft, the Northrop 2E long-range light bomber, and the British press and aviation industry were invited to inspect it closely. With its large radial engine, fixed and heavily "trousered" landing gear and exposed bomb load, the Northrop was approaching obsolescence—even by 1937 standards. It had one major asset, however: it could carry a load of just under 95 percent of its empty weight. Until then, a wide range of British aircraft had achieved only a 65 percent ratio of load to empty weight.

With WW II on the horizon, the Northrop's carrying capability provided great range and allowed a heavy bomb load or cargo of other armament; this was of vital significance to the British. In an article titled "Lessons from American Construction," *The Aeroplane*—a British magazine—published this explanation:

"There is no doubt that this has been done by following the sound engineering principle of placing material in the most economical position at the greatest possible distance from its 'neutral axis.' The Northrop is an example of the merits of the lobster-shell [i.e., stressed skin] style of construction. The metal covering plays an important part throughout the Northrop. Only the ailerons have fabric covering over a metal frame."

To understand the neutral axis concept, you must have at least a nodding acquaintance with forces and certain laws of physics:

- **Tension**. In a tug-of-war competition, the rope is under tension.
- **Compression**. A column supporting a roof is under compression.
- **Shear**. Two overlapping sheet-metal skins, riveted through the overlap and put under tension, will stress the rivets in shear on a line between the two sheets.
- **Elasticity and the elastic limit**. Music wire (or a balsa stick) bent within its elastic limits will rebound to its original shape when the bending force is removed. If bent beyond their elastic limits, the wire will be permanently distorted, and the balsa stick will snap. To avoid distortion or collapse, the maximum stress to which a structure may be subjected must not exceed its elastic limit.
- **Leverage**. Two boys sit on opposite ends of a seesaw. One weighs 100 pounds and is sitting 3 feet from the fulcrum; to balance the seesaw, a 60-pound boy must sit 5 feet from the fulcrum, or a 50-pound boy must sit 6 feet from it. If the seesaw's fulcrum is considered to be the neutral axis, then it is obvious that the greater the distance from the axis, the less weight, or strength, is required to overcome a fixed load. Less strength means less weight. This is the crux of the neutral axis concept.



The Osprey, flaps-down and close to a stall. Its ailerons are effective, thanks to the NASA droop visible in front of the ailerons.

All of these conditions occur in both bending and torsion (twisting) of materials used in planes. Figure 1 shows a typical balsa, cantilevered wing spar bent under lifting loads. The fibers on the upper side are under compression; those on the underside are under tension. At the centerline, the two forces oppose each other in shear along the neutral axis.

In Figure 2, A is a cross-section of the balsa spar in Figure 1, and B is another cross-section with the same area as A. Obviously, B is much stronger in bending than A because the material is farther from the neutral axis, and it exerts more leverage. The shear web of B is balsa with its grain running vertically. It serves two purposes: it absorbs the shear loads at the neutral axis (balsa is stronger in shear across its grain than along the grain), and it prevents the upper flange from buckling under compression loads. C is another spar of reduced cross-section compared with 2A. It is almost as strong as A, but it has only 0.125 square inch of cross-section area versus the 0.375 square inch of A. The weight savings is obvious.

The strength of a beam is proportional to its width and the square of its depth but is inversely proportional to its length.

In Figure 3, a tube is twisted in opposite directions at its ends, placing it under torsion. The material is also under shear, as

the shearline arrows show. Simultaneously, the twisting action elongates the material and puts it under tension. In Figure 4, A is a solid cylindrical rod; B is a hollow cylinder made of the same material as A and with the same cross-section area. It is obvious that B is much stronger than A in both torsion and bending owing to B's greater leverage from the neutral axis. B could also be made with even thinner walls to provide strength equal to that of A at a considerable reduction in weight.

Full-scale airplane fuselages have thin skins that are prone to local buckling; however, this is prevented by the use of lateral frames and longitudinal stringers. Balsa sheet is stiff enough to avoid the need for stringers; only frames or bulkheads are required for model aircraft.

Tension members may have solid cross-sections; members under compression need to have their material as far from the neutral axis as possible to avoid bending or buckling. Tubular H-shapes are indicated.

With the neutral-axis concept in mind, it is apparent that the leverage should be as great as possible. This suggests that a model's structure should form its outer surface—its so-called "stressed skin."

Thick wing and tail airfoil sections and wider, deeper fuselages obviously increase leverage and permit a reduction in weight, but this results in undesirable, increased aerodynamic drag; a compromise is necessary.

WINGS

A wing in flight must bear a variety of loads: bending from lift, profile and induced drags and torsional loads caused by the airfoil's pitching moment, the twisting action of aileron use and the increased pitching moment of extended flaps. Centrifugal force substantially increases these loads as the plane performs maneuvers.

High aspect ratio wings have lift centers that are farther from the fuselage than others'; this causes increased bending loads at the wing roots. Their narrower chords result in thinner wings that are less able to resist torsion.

Tapered wings have wider, deeper root airfoils that provide greater leverage from the neutral axis and, hence, greater strength where it is most needed. They are more complex; the ribs are all different, and on smaller models, the narrow tip chords are subject to adverse scale effects, increased drag and reduced stalling angles. For .40- to .46-powered models, this author favors straight, untapered wings with aspect ratios not exceeding 6.5. Thicker airfoils, such as the Eppler E197 (which has a 13.42 percent ratio of thickness to chord) are suggested. The Eppler airfoil has low profile drag, a maximum lift coefficient of 1.17 and gentle stall characteristics. Its nose-down pitching moment is offset by its virtues, and its depth permits a strong yet light structure.

Figures 5 and 6 illustrate the wing structure of the author's "Osprey." This model had a wingspan of 71 inches, a wing chord of 11.3 inches and a gross weight of 113 ounces. Power was provided by an O.S. Max .45 FSR engine. The Osprey's wing airfoil was the E197. Figure 5 shows the flapped portion, and Figure 6 shows the aileron section with the NASA droop. In Figure 5, the ¾-inch trailing-edge stock forms the slot lip and resists the shrinkage of the covering.

This structure incorporates the spar design shown in Figure 2C and the "tubular" form of Figure 4B. The sheet-balsa skin handles torsion and drag loads and adds to the bending strength.

For models that have wing loadings of 20 ounces per square foot or less, the sheet-balsa skin between the spars on top and bottom may be omitted and replaced by capstrips. A modest weight saving results, but the airfoil cross-section is distorted by the sags in the covering between spars and ribs. Complete balsa skins are suggested for higher wing loadings.

The flaps and ailerons are simple hollow structures with a few ribs and have proved to be strong, light and easy to make. The neutral axis concept already applies. As shown in Figure 6, the NASA droop ahead of the ailerons improves control at high angles of attack.

Figure 7 illustrates the open-wing center section that strengthens the wing in bending, but weakens it torsionally. The four-bolt attachment of the wing to the fuselage allows the fuselage structure to absorb torsion loads.

Figure 1. Spar under lifting load.

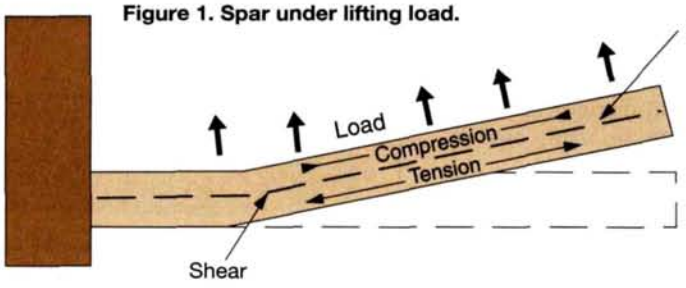


Figure 2. A, B and C. Typical spar comparison.

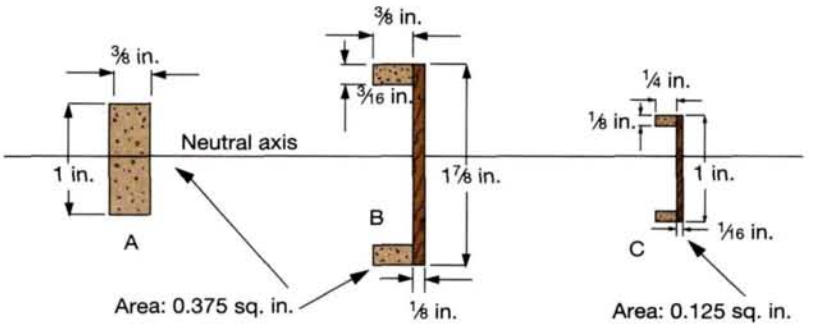


Figure 3. Torsion and shear.

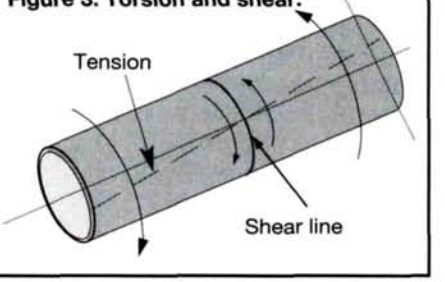
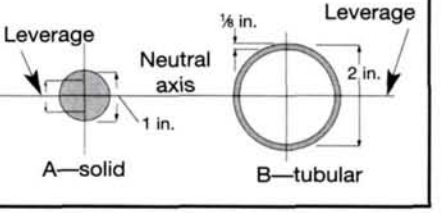


Figure 4. A and B have the same cross-section areas.



Swept wings must be strong in torsion. The center of lift tends to twist the wing leading edge downward, and this reduces lift. The center of lift of a swept-forward wing is ahead of the wing root. Lift tries to twist the wing leading edge upward; this increases the lift and torsion. Unless such wings are strong torsionally, flutter or failure can occur.

TAIL SURFACES

Tail surfaces must absorb the heavy bending and torsional loads caused by the use of elevator and rudder. Figure 8A illustrates a typical tail-surface structure in cross-section. The thickness of the E168 airfoil is 12.7 percent of its chord.

Tail surfaces that have symmetrical airfoils are much more effective than the

typical ¼-inch balsa slab or flat, built-up types, and this stressed-skin structure is light, strong and easy to make.

Figure 8B illustrates a fin-and-rudder cross-section of a T-tail model. The added spar shown has proven, on many models, to be strong yet light.

Elevators and rudders, like ailerons, are simple box structures. Horns on all control surfaces are 1/16-inch-thick plywood ribs that are an integral part of the "parent" structure as shown in Figure 8B.

The double MonoKote hinges on ailerons, elevators and rudder have been used on many models. They are durable, flex easily and provide a gap seal that significantly improves the aerodynamic function of the hinged surfaces.

Figure 5. Typical stressed-skin wing section at slotted flap.

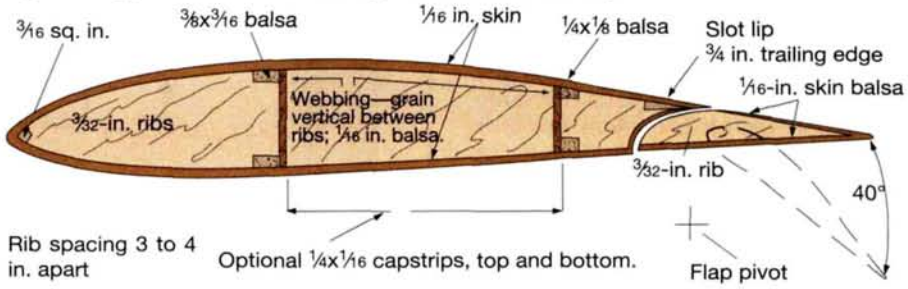
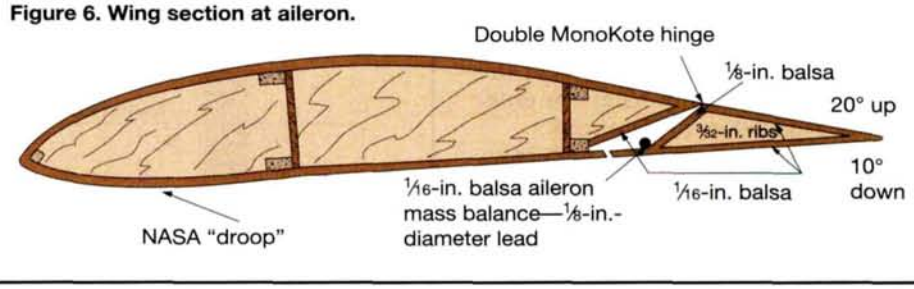


Figure 6. Wing section at aileron.



FUSELAGE

The fuselage is subjected to many stresses: tension from thrust, torsion from torque and aileron action, bending caused by elevator and rudder action and severe bending loads in hard landings.

A cylindrical shape is best suited to absorbing these loads. Close to cylindrical is a fuselage with a sheet-balsa top, bottom and sides with the grain running fore and aft and generously rounded balsa corners, as shown in Figure 9, with a few well-situated frames. The material is as far from the neutral axis as it can be.

For high- and shoulder-wing configurations, this author favors a removable canopy that includes the windshield and extends from the motor bulkhead to the wing's trailing edge. Held by dowels at the front and by one nylon bolt at the rear, it is easily removed. This is a real convenience at the flying field; when you remove the canopy, the fuel tank, nosewheel steering, engine control linkage and all the servos are exposed. The canopy conceals the bolt that attaches the wing to the fuselage.

The forward fuselage is weakened by the canopy. It is reinforced at the wing attachment points. Forward of the wing, doublers and gussets along the open, top sides reinforce the fuselage but do not prevent ready access to the tank, the servos, etc., as in Figure 9.

Fuselage bulkheads

Figure 7. Wing center section detail

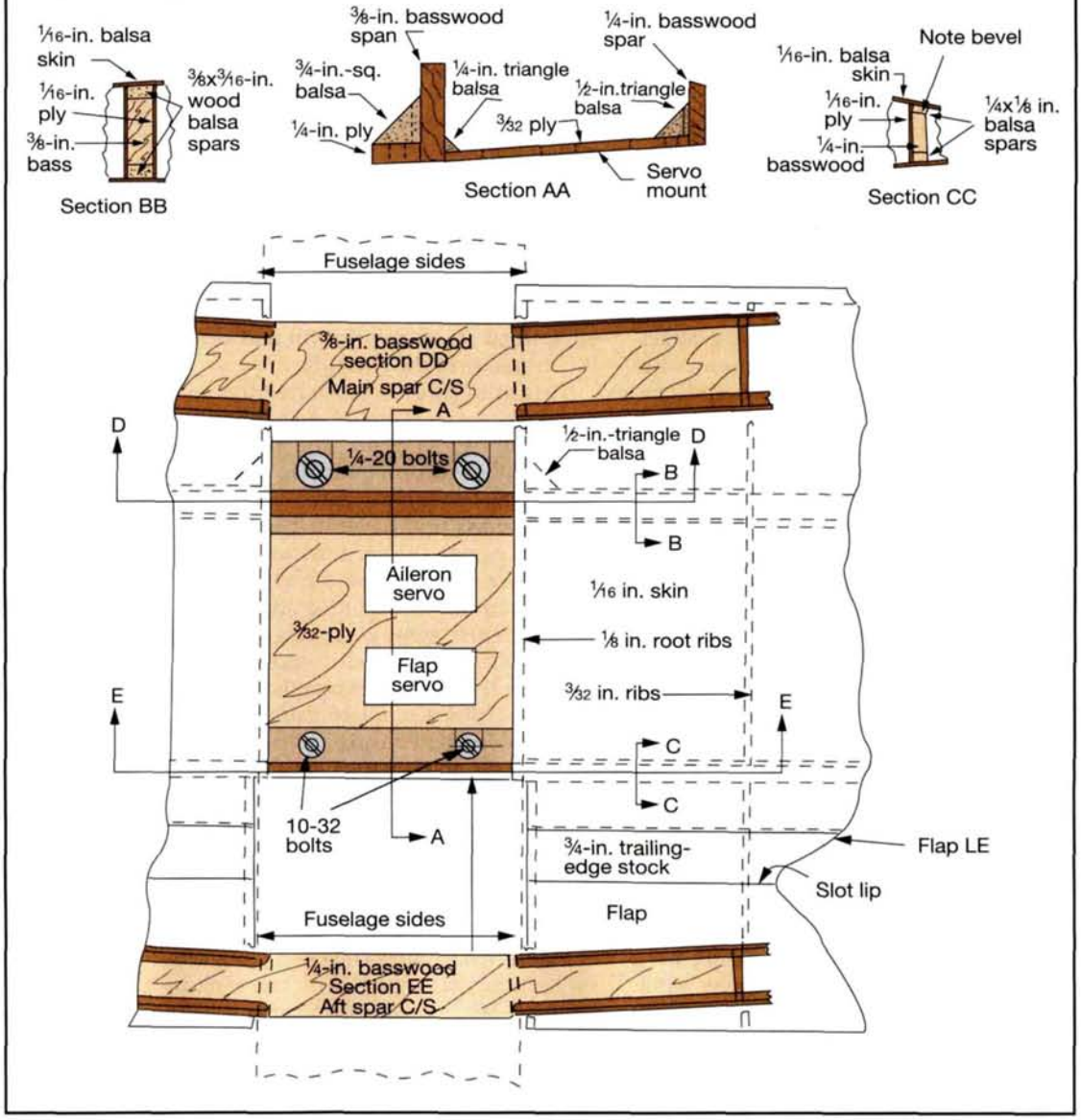


Figure 8. Stressed-skin tail surfaces.

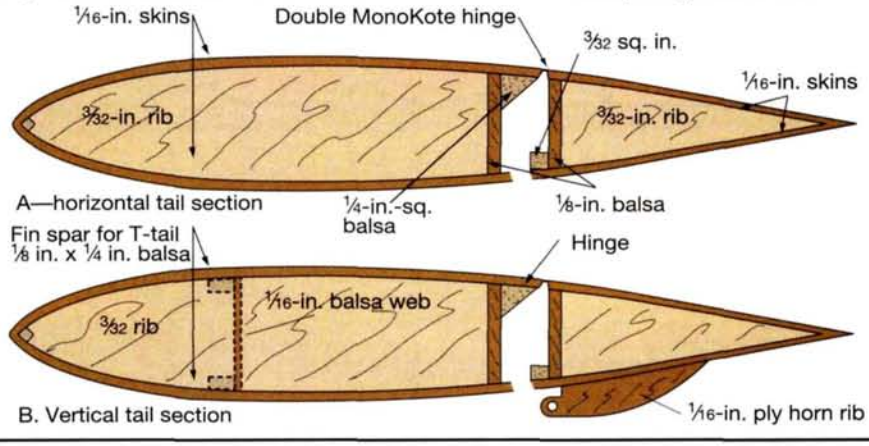


Figure 9. Fuselage sections.

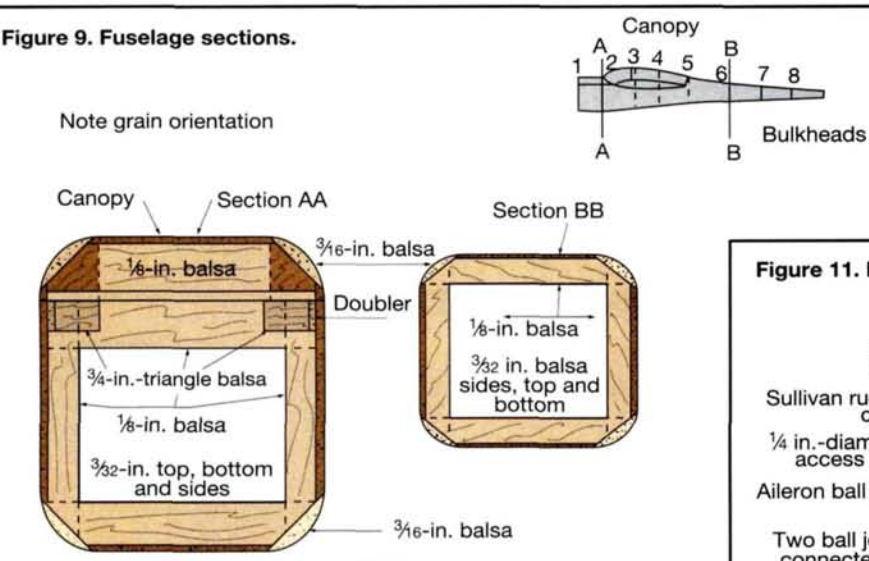
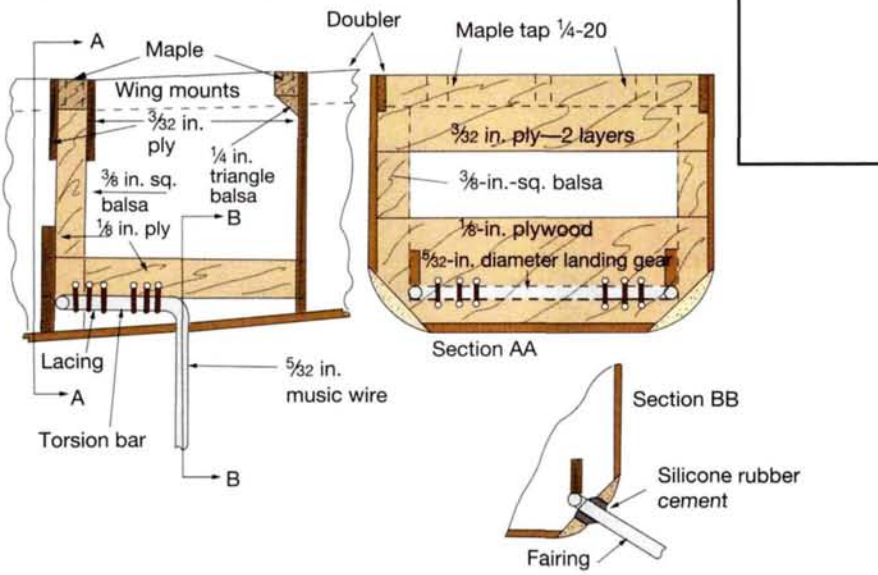


Figure 10. Main landing gear design



absorbing the wing loads should be situated to suit the center-section bolting arrangement. They should also do double duty by absorbing landing-gear loads, as in Figure 10.

LANDING GEAR

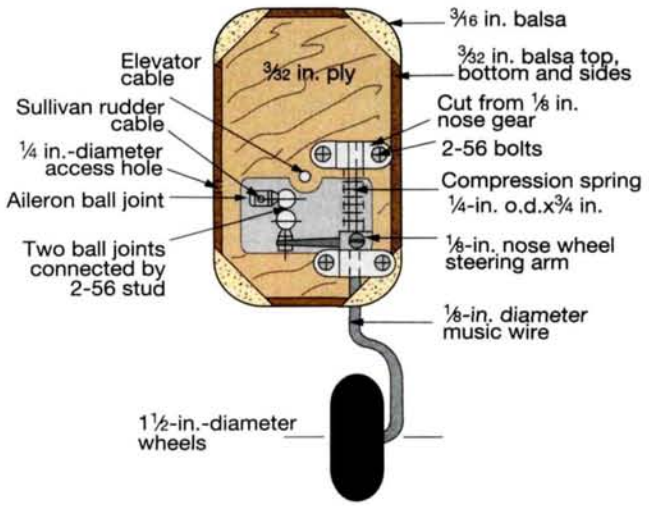
Main landing gear can be made out of sheet aluminum, composite materials or music wire. Gear should be in one piece from wheel to wheel so that the flexing loads are contained in the gear and are not transmitted to the fuselage structure. This calls for in-fuselage-mounted gear.

The author favors 5/32-inch-diameter music wire for .40- to .46-powered models. Bending the wire to form a squared U-shape in the fuselage, with the sides of the U running fore and aft, provides a torsion-bar suspension, as the sides of the U twist under load (see Figure 10).

Another advantage is that the U bridges the wing. Mount the bulkheads so that the landing loads are spread out, as in Figure 10. The open side of the U faces forward for tail-draggers and aft for tricycle gear.

Balsa and ply fairings on music-wire landing gear greatly reduce the high drag of bare wire. These extend into the fuselage structure through enlarged slots. Fill the space between the fuselage and the fairing with silicone rubber cement (Figure 10, section BB) to form a neat fairing that permits the gear to flex without damaging the fuselage. Mount a tricycle nose gear on the rear side of the engine bulkhead using two brackets. The shock-absorbing coil should be inside the fuselage to reduce drag. A longitudinal slot in the fuselage bottom permits the gear to flex backward without damaging the fuselage.

Figure 11. Forward tailwheel design



Tailwheels can be mounted on brackets at the rudder post with a steering arm attached to the rudder. This author prefers the tailwheel to be farther forward and mounted on a plywood bulkhead, as shown in Figure 11. This arrangement allows good shock absorption, and a ball joint coupled to a rubber cable provides steering. This setup was successfully used on the Osprey.

Adhering to the principle of locating structural material as far from the neutral axis as possible will maximize strength and minimize weight.

**Addresses are listed alphabetically in the Index of Manufacturers on page 142* ✦

MODEL AIRPLANE NEWS
PRODUCT
REVIEW

Affordable, user-friendly 5-channel radio

JR XF421EX

by Bob Aberle

If you don't own a computer radio because you think they're difficult to program or they cost too much, the folks at JR* may have a pleasant surprise for you.

The JR XF421EX RC system is an easy-to-learn computer radio. It has plenty of special control features for beginners or RC sport fliers at an attractive price. This 5-channel FM system has two-model memory (both memory positions can be named), servo reversing, endpoint adjustments (EPA) on all channels, trainer capability and the ability to control flaperons, delta wing, or V-tail-type models. It has a fifth, non-proportional channel to operate a retract system, flaps, or other accessory, but it doesn't have a dual rate or exponential rate control feature. The V-tail and delta-wing features will work well with RC hand-launched or catapult-type glider models. This radio would also fit the bill for many slow flyers, parking-lot flyers and even indoor RC models.

PHOTOS BY BOB ABERLE

ABOUT THE SYSTEM

The JR XF421EX RC system includes a 5-channel FM transmitter, 6-channel FM receiver (one channel function is not used), four NES-517 servos, dual-output battery charger, airborne Ni-Cd battery pack, switch harness, aileron extension cable, extra servo output arms and mounting hardware, frequency flag set and a very complete, easy-to-read instruction manual. The transmitter operates on FM (PPM) with deviation on the high side. The system is available on the 72MHz RC channels as well as on the 6-meter Amateur Radio Service (ARS) channels. There is no removable RF module for changing channels. The crystal is accessible from the rear of the transmitter case, but keep in mind that it's illegal to swap transmitter crystals. Also be aware that a built-in lithium battery provides backup for the computer memory. This battery has a service life of five years; then the transmitter must be returned to the factory so the battery can be replaced.

ABOUT THE TRANSMITTER

The dual-stick transmitter is comfortable to hold. Trim levers are the traditional ratchet type, not digital. Control-stick length can be adjusted, but the spring tensions on these sticks cannot. At the rear of the transmitter is a compartment for the 8-cell, 600mAh Ni-Cd battery pack. This pack is easily accessible and has its own connector so it can be quickly removed. A low-voltage alarm will sound when the transmitter voltage goes below 9, and the word "BAT" will flash on the LCD screen as a warning to recharge. Note: JR radio systems use a charging jack with a negative center pin and a positive outer sleeve.

A direct servo connection (DSC) cable jack is on the rear of the transmitter case. The DSC allows you to operate the controls in your aircraft without actually transmitting a signal. You can adjust various controls in the pit area without interfering with other modelers. To use this DSC feature, you will need to buy a DSC cord and deluxe switch harness from JR. The DSC jack also functions as a trainer cable port. This cable will connect any two JR transmitters to provide a buddy- box system. Pressing a switch on the top left corner of the case transfers control from the instructor to the student. If the student needs help, the instructor lets go of the switch and regains control of the model.

At the top right corner of the transmitter case, a two-position switch operates a fifth, or auxiliary, channel. This non-proportional channel can be used to operate retracts or deploy flaps. The 1½x1-inch LCD screen displays all of the computer system controls. When the transmitter is turned on, a display indicates the model memory position: either "MD1" or "MD2" (or the name you've assigned to it) and the battery voltage.

Computer input control commands are input into the system with two push-button switches on the left and right sides of the upper front panel. The radio has two basic menus: system setup mode and function mode. To get into the system setup mode, you must push both the "SCROLL" and "+INCR" buttons upward and turn on the transmitter power. This is a bit difficult, since the switches are about 6 inches apart. Once in the systems setup menu, you can return to original factory settings, choose model-memory position one or two, select flaperons, delta or V-tail mixing and name the memory position with up to three characters or numerals. To pull up the function mode with the

The fifth channel retract or flap switch is at the top of the case on the right side. This is not a proportional channel. The computer-input switch on this side is identified as +INCR or -INCR. To enter control inputs, toggle the switch up or down.

At the top left corner is the trainer switch handle, which is the momentary-contact type. SCROLL/CHANNEL switch provides computer-input commands. The switch moves up to scroll around the menu or down to scroll around the five channel functions.

SPECIFICATIONS

Model: JR EF421EX

Distributor: Horizon Hobby Distributors

Transmitter: 1 lb., 11 oz., 5-channel dual stick (Mode-II), two-model memories intended for fixed-wing-aircraft control. The RF module is built into the case and is not removable. Charging jack has center pin as negative. Blocking diode prevents testing or cycling of the battery while inside the case, but the pack can be easily removed. A low-voltage alarm sounds and "BAT" flashes on LCD screen when voltage goes below 9.

Receiver: JR R600, weighs 1 oz., uses JR ABC&W circuitry, has six available channel functions (only five used in this application). JR proprietary connectors plug into the end of the case.

Servos: four JR NES-517 with ball-bearing-supported output shafts, 1.5 oz. (each), output 40.3 oz.-in. and transit time 0.25 second for 60-degree rotation. Generous 11-inch-long servo cables.

Accessories: switch harness with bulkhead mount charging jack, 4-cell, 600mAh airborne Ni-Cd battery pack with heat-shrink wrap case, dual-output battery charger, aileron extension cable, servo-mounting hardware and extra output arms, frequency flag set and an excellent instruction manual.

Weight of complete airborne pack: 11 ounces (receiver, four servos, switch harness, battery and aileron extension cable).

Street price: $179.99

Features: 5-channel, two-model memory, computer radio available on 72MHz and the 6-meter Amateur Radio Service (ARS) channels. Modulation is FM (PPM) with high side deviation that is compatible with Airtronics* RC equipment as well.

Comments: the JR XF421 RC system is an excellent way to break into the computer radio system field. It is easy to learn, easy to operate and includes many control features at an affordable price.

Hits

- Easy to learn how to operate; especially good as a first-time computer radio system.
- Just enough extra control functions to provide convenience without complications.
- Mixing circuit provides a choice of flaperon, Delta wing or V-tail-types of control.

Misses

- Lithium backup battery requires factory replacement after five years.

transmitter power on, just move the SCROLL and +INCR switches upward. This will access servo-reversing, EPA and subtrim for all five channels. The endpoint adjustment allows you to set the distance that your servo travels from 100 percent down to 0 percent of servo movement. You can also easily set more "up" than "down" or "right" than "left." You can also establish high and low engine-throttle positions without mechanical adjustments. The last control is subtrim, which allows you to return the mechanical trim levers to their neutral positions by adjusting the servos' actual neutral position. As a result, the control surface, such as elevator, may have a slight upward trim, yet the elevator trim lever has been reset to the neutral position. All settings are automatically saved when you go to another menu or simply turn off the power.

The rear of the transmitter, showing the battery box open and the 8-cell, 600mAh pack removed. This pack can easily be unplugged for testing or substitution. In the right corner is the DSC, or trainer cord jack.

The normal display comes on every time the transmitter is turned on. MD1 is the number-one model-memory position; you can name it with up to three letters or numbers. The "10.4V" is the battery voltage.

Under the function menu, you will find servo-reversing (as shown here), subtrim and endpoint adjustments.

AIRBORNE GEAR

The tried and proven R600 FM 6-channel receiver measures 2x1⅜x⁹⁄₁₆ inches and weighs just 1 ounce. The connectors all plug into the end of the case, which makes for a compact installation. The connectors have the industry-standard positive center lead. The color coding is brown (negative power), red (positive power) and orange (signal). This receiver conforms to all AMA guidelines and is in compliance with FCC regulations.

NES-517 servos with ball-bearing-supported output shafts are supplied. Rated output is 40.3 oz.-in., and the rated transit time is 0.25 second for 60 degrees of rotation. Each servo weighs 1.5 ounces, and the cable length is a very generous 11 inches.

A 600mAh battery pack is also provided. It is wrapped in heat-shrink tubing and weighs 3.2 ounces. The total airborne weight of the receiver, four servos, battery pack, switch harness and aileron extension cable is 11 ounces.

The instruction manual that comes with this system is about as thorough and easy to read as you could ever find. Best of all, with the purchase of a second airborne system, you can operate two separate model aircraft from just one transmitter.

SUMMARY

Mastering this entry-level computer RC system will open the door to mastering higher level JR equipment later. The JR XF421EX is easy to learn, easy to operate and has many useful control features at an affordable price.

The airborne components that come with this system, including the four NES-517 ball-bearing servos (total airborne weight is 11 ounces). The JR R600 FM 6-channel receiver weighs just 1 ounce and is only ⁹⁄₁₆ inch thick. All connectors plug at on the end of the case.

**Addresses are listed alphabetically in the Index of Manufacturers on page 142.*

PRODUCT WATCH

Editors' picks of the month

AT MODEL AIRPLANE NEWS, we not only tell you what's new, but we try it out first to bring you mini-reviews of the stuff we like best. We're constantly being sent the latest support equipment manufacturers have to offer. If we think a product is good—something special that will make your modeling experiences a little easier or just plain more fun—we'll let you know here. From retracts and hinges to glow starters and videotapes, look for it in "Product Watch."

ELECTROTEK

Gem 2000

Watchful eye

The Gem 2000 from Electrotek ($34.95) is an electronic early warning system for your airplane. Just plug the connector into your receiver, and the Gem monitors continuously and alerts you to servo binding, low battery voltage, or problems with the radio-frequency filter and receiver crystal; it also reminds you if the receiver switch is on or off. The GEM 2000 comes in a 4.8 or 6V model with connectors for all popular radio brands. As soon as you turn on your airborne switch, the Gem 2000's "laser-bright" LED blinks at a steady pace—assuming everything is OK. Any change in the LED intensity or rhythm is an indication of a problem. The Gem 2000 is furnished with a diagnosis chart that guides you to the detected problem. You have your choice of either case-mounted LED or remote. The 7.1g unit is about the size of a microservo and draws only 0.004 amp at 5 volts.

Electrotek offers an unconditional lifetime warranty and, if you buy three of the units within one year, they will send you a fourth one free.

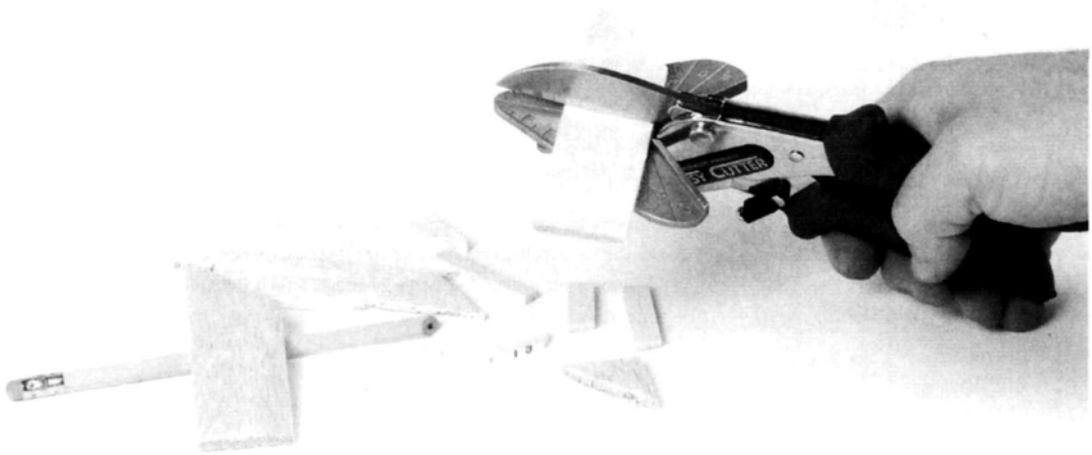
—Craig Trachten

Electrotek, 14667 Lafayette Cir., Magalia, CA 95954; (888) 567-2862.

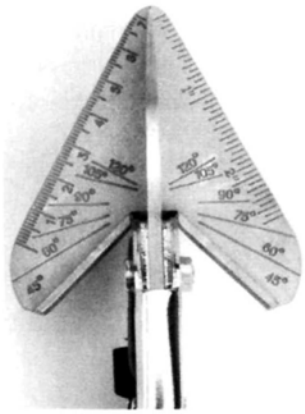
MIDWEST PRODUCTS CO. INC.

Easy Cutter

Shear brilliance

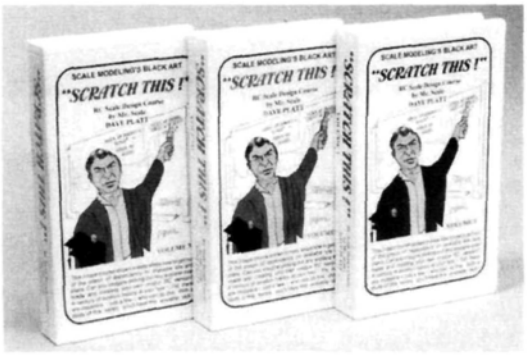


If you're a scratch-builder, or if your kits are full of sticks, your life just got a lot easier. Midwest Products' new Easy Cutter ($19.99) may be the most significant modeling product since the electric hinge slotter. The Easy Cutter quickly cuts stripwood at precisely the angle you need. To cover the most angles, there's a 45-degree fence on each side and a flat guard for 90-degree cuts. The tool is segmented at 15-degree intervals from 45 to 120 degrees, and a ruler is etched on either side of the deck. All you do is disengage the safety, place your stick at the angle you need and squeeze. How well does it cut? In a word: great. I cut up a slew of sticks that included up to ¼-inch balsa, ply and spruce, and when I ran out of wood, the pencil on my desk. Where was this thing when I put together my first Kadet Senior? The cut wood is remarkably clean, no doubt because of the 0.002-inch tolerances that the Easy Cutter is manufactured to. Be sure to keep the center groove clean; otherwise, your cuts will have frayed ends. I'm really impressed by the time I saved with this tool. If someone decides to prune the front hedges with the Easy Cutter, fear not; Midwest offers replacement blades.



—Bob Hastings

Midwest Products Co. Inc., P.O. Box 564, Hobart, IN 46342; (800) 348-3497; www.midwestproducts.com.



DAVE PLATT MODELS

Scratch-Building Videos

Tipping the scale

A couple of years ago, master designer and builder Dave Platt introduced a series of videos aimed at teaching his techniques for building, painting and weathering models. Videotaped in his own workshop, Dave's "Scale Modeling's Black Art" tapes are an excellent way to learn scale modeling from the inside out.

Dave has added three more tapes to his popular collection under the title "Scratch This!" At $34.95 each (or all three for $95), they cover just about every aspect of scratch-building scale model airplanes. Each tape runs for about two hours; volume 1 addresses topics such as choosing a subject aircraft, finding good 3-view drawings and deciding how big to make your model. We also see a couple of his models: an in -progress Hawker Hunter jet and a WW II Japanese Val dive bomber. Then, with a simple chart, Dave introduces us to a simple way of quickly estimating a model's potential, and he shows us how to use "area factor" to compute wing area, tools and materials needed for drawing plans, how to loft airfoils and establish landing-gear geometry.

Volume 2 explains NACA airfoil coordinates and how to use them to draw an accurate airfoil. His talk on airfoils and the NACA airfoil numbering system is particularly informative. To make his point, Dave uses a 3-view drawing of a Grumman Guardian to explain the model designing process. He goes on to structural design, engine and fuel-tank placement and fuselage layout. Rib spacing in the wing, force arrangements and drawing ellipses and parabolic arcs are shown in detail.

Volume 3 covers CG location, wing structures, muffler design, engine side- and downthrust, sliding canopies and making fiberglass engine cowls. My review only scratches the surface of the "Scratch This" series; there is much more information in each volume.

If you're a scale modeler or want to become one, Dave's tapes will guide you along the way as you move on to becoming a designer. If you really want to scratch-build model airplanes, you'll see that the sky is truly the limit.

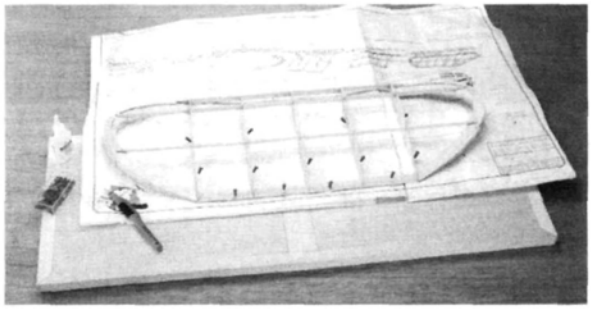
—Gerry Yarrish

Dave Platt Models, 1306 Havre NW, Palm Bay, FL 32907; (321) 724-2144.

PAUL F. GUILLOW INC.

Balsa building board

Transportable workshop



I don't have a dedicated workshop space, so when I built my first small model, someone recommended that I use a ceiling tile as a building board. Well, the tile was heavy, it was too short to build an entire wing half or fuselage on, and pins didn't stick into it easily or securely. As if that weren't enough, the tile's edges "shed" bits of material everywhere. When I saw an ad for the Guillow building board, I knew immediately that I had to have it.

Because the board is made of balsa, it's easy to stick pins into, and the pins securely hold parts while glue dries. The pinholes won't leave permanent marks, either. I've found that this board is easy to carry, and it's totally smooth—no splinters! The board is framed to help prevent warping, and the frame has mitered corners—a nice touch. It's available in 36- and 48-inch-lengths.

If you keep the board dry and always cover your plans with wax paper or a see-through plans protector before you glue any parts, you'll have this building board forever; I know I plan to!

—Debra Sharp

Prices—$23.98 (36x14x1-inch board); $26.98 (48x14x1-inch board), plus $6 S&H.
Paul K. Guillow Inc., P.O. Box 229, Wakefield, MA 01880; (781) 245-5255; fax (781) 245-4738; guillow@aol.com.

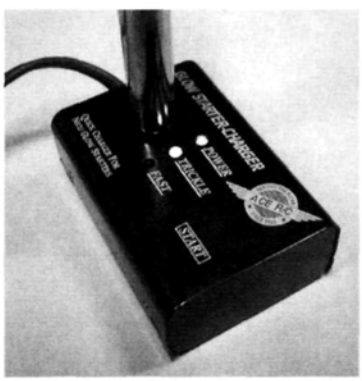
ACE R/C

Glow Starter-Charger

We have ignition

If your day at the field has lasted longer than planned, or you gave your glow igniter a workout trying to fire up a stubborn engine, how can you recharge it at the field?

Ace has a handy item for your fieldbox for just such occasions. The Glow Starter-Charger ($19.99) will have your igniter back up to snuff in only 20 minutes. In a gunmetal-gray case, three LEDs indicate power, trickle and fast charge. Simply connect the Glow Starter-Charger to a 12V source, and plug your igniter into the unit. Press the start button, and the unit will charge for 20 minutes. You can also leave your glow igniter connected at the trickle setting for a maintenance charge; in this way, you'll never be caught without a charged igniter. Even if you hard-wire the charger, you can leave the igniter plugged in while you top off your fieldbox's 12V source. If you like being prepared, put Ace's Glow Starter-Charger on the shopping list for your next trip to the hobby shop.



—Bob Hastings

Ace Hobby Distributors, 116 W. 19th St., Higginsville, MO 64037; (660) 584-7121; www.acehobby.com.

New kits and gear-door tricks

SCALE MAIL

I recently received a letter from my good friend Bob Campbell of North Canton, OH, and he included a photo of his newest IMAC design—a 45-percent Stephens Acro. Bob has been involved in giant scale for a long time, and he continues to build and fly his own designs. His version of the Acro has a 10-foot, 8-inch wingspan and weighs 32 pounds. He used foam for the fuselage and the wing and covered it with ⅛-inch balsa, which he finished in MonoKote. The finished model looks very nice and, in Bob's hands, should be an excellent flyer.

I also heard from Jim Kiehl, whom I met several years ago at the Warbirds over Delaware meet. Jim designed the Me-163 Komet (built by Sal Calvagna) that I showed you several months ago, and he said he was working on some other designs and would send me more information later.

Well, his newest model is an unusual Me-328 powered by twin electric Hi-Line Red Flame Blaster fans. The motors get their power from a 7-cell, 500mAh AR pack, and the fans draw 16 to 18 amps and turn at 26,000rpm. With a wingspan of 42 inches, the model weighs only 30 ounces! The fuselage has bulkhead-and-stringer framing and is sheeted with 1/16-inch balsa finished in red MonoKote.

I always enjoy receiving mail and photos from ingenious "Scale Techniques" readers; I'm intrigued to see the many scale designs they develop. A lot of research, design work and prototype experimentation are required to bring any model to its eventual flying configuration, and I'm happy to share their ideas. Nice going, guys!

Right: Bob Campbell's 45-percent-scale Stephens Acro is made of foam (wing and fuse) and covered with balsa. Left: Jim Kiehl designed and built this unusual, 42-inch-span Me-328, which he powers with electric ducted fans.

Robart's new fiberglass P-38 Lightning kit is based on Nick Ziroli's design.

BIG LIGHTNING IN GLASS

A few years ago at the Long Island, NY, Scale Masters qualifier, I saw Nick Ziroli Sr.

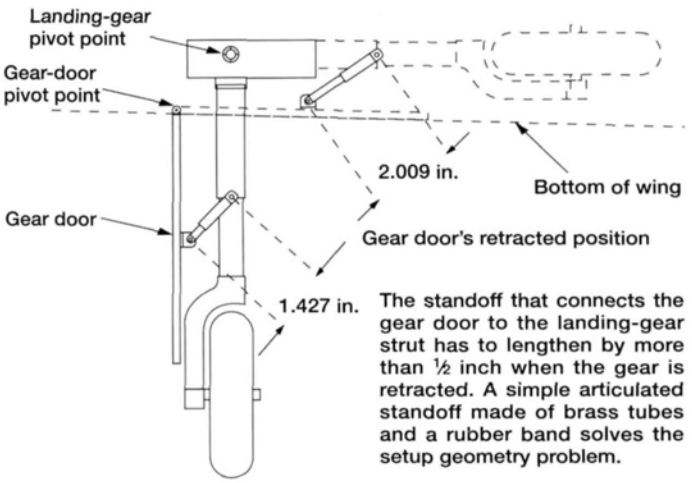
TECHNIQUE OF THE MONTH

ARTICULATED GEAR-DOOR STANDOFFS

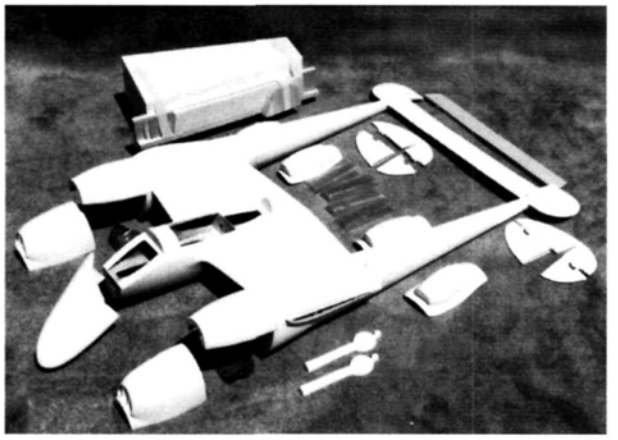
Although I have slightly modified it to suit my own applications, this technique comes from Bruce Saunders of Century Jet Models*. Standoffs are those little tubes or other attachments that connect the gear doors to the retractable landing-gear struts. These devices pull and push the gear doors to open and close them when the landing gear extends and retracts.

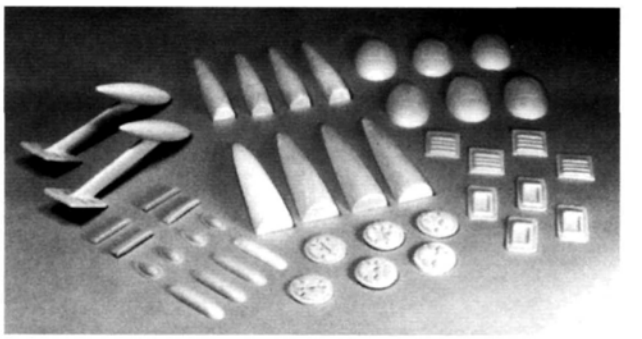
For years, I bent lengths of wire to use as standoffs; it was difficult to get them just the right length to pull my gear doors tightly into place when the gear strut retracted; in fact, this often took more time than it did to install the retracts themselves. Using solid wire poses problems because the angle and distance between the door hinge and the gear strut change when the gear moves. Bruce's method is much easier. Let's try it.

Figure 1. Articulated landing-gear-door standoff setup.



The standoff that connects the gear door to the landing-gear strut has to lengthen by more than ½ inch when the gear is retracted. A simple articulated standoff made of brass tubes and a rubber band solves the setup geometry problem.





Left: the kit includes the entire fuse center section (including the tail booms in a single molded piece) and installed bulkheads. Right: try Robart's resin-cast scale parts for the P-38 Lightning kit.

fly his then-new giant-scale P-38 Lightning. His static score was very high, and he won the event. On one flight, one of the Lightning's engines started to run roughly and then stopped. Nick proceeded to fly it on only one engine, and he brought the model around for a perfect landing. Nick is an exceptionally good pilot, and with Zenoah G-45s for power, the P-38 made a very big impression on me.

Nick sells the plans for the Lightning, and there are several places where you can buy wooden kits of his model: Madden Model Products* and Chuck Gill's The Aeroplane Works* quickly come to mind.

Well, the good people at Robart Mfg.* have taken Nick's design to the next level and now offer it as an impressive fiberglass kit. It has a 114-inch wingspan and features a one-piece, molded, center section (including the tail booms)—all gelcoated. The fuselage formers come installed, and Robart retracts can be bolted right into place.

The plug-in wing panels have foam cores, and the kit comes with front and rear aluminum spar blades and sockets. Many accessories are included in the standard kit, but this is where the Robart P-38 gets even better: option packs may be bought separately or with the kit; options:

No. 1. Robart ZP-38 three-gear retract set.

2. Retract and gear-door air-control kit (includes a control valve, air tanks, pressure gauge, gear-door valves, etc.).

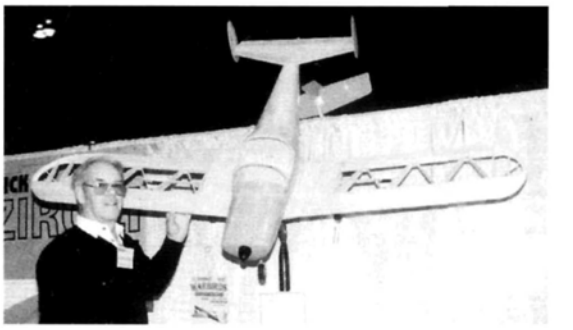
3. Detail-accessory kit that includes: molded upper and lower scoops, fuel-tank caps, elevator counterbalances, navigation-light housings.

This unique version of Nick's P-38 is available directly from Robart, so if you need a good flying twin design, give them a call.

ZIROLI ERCOUPE

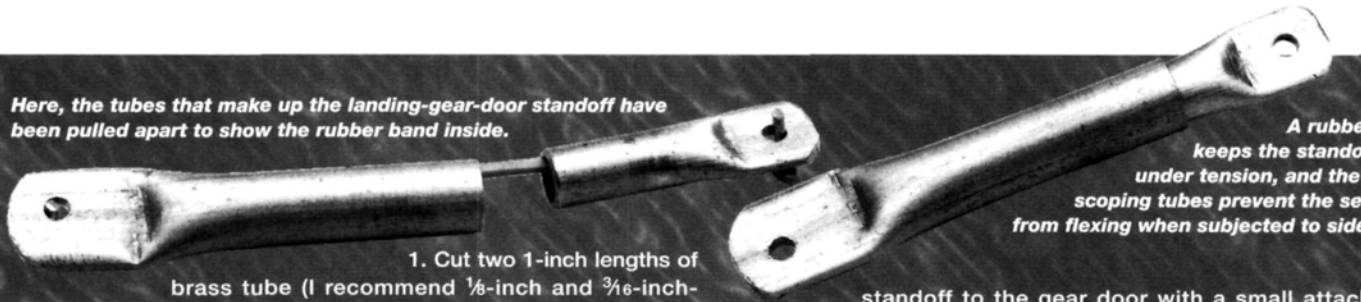
If Nick's big Lightning is too much for you, why not take a look at his newest design, the Ercoupe? This twin-tail model has fixed gear (available from Robart) and a modest, 80-inch wingspan, and it was designed around the popular Zenoah* G-23 gas engine, so it has plenty of power. I bumped into Nick at the last World Miniature Warbird Association meet in Kirkwood, NY, where he was having a ball flying this model (dressed up in military colors, the Ercoupe is a legal warbird!). The plans, fiberglass parts and nifty-looking shock-absorbing Robart landing gear

Nick Ziroli Sr. shows off his 80-inch-span Ercoupe's framework; a plan and formed parts are available, as is a wooden kit.



Here, the tubes that make up the landing-gear-door standoff have been pulled apart to show the rubber band inside.

A rubber band keeps the standoff under tension, and the telescoping tubes prevent the setup from flexing when subjected to side loads.



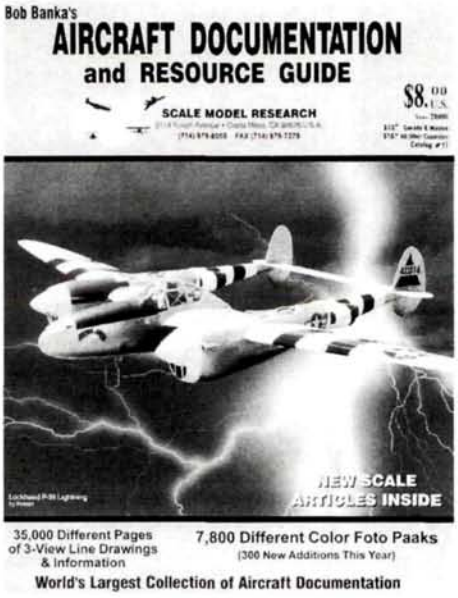
1. Cut two 1-inch lengths of brass tube (I recommend ⅛-inch and 3⁄16-inch-diameter tubes), and insert the narrower tube into the wider one. Cut a 3-inch piece of rubber band and slip it through the tubes. Pull the narrower tube out of the other by ¾ inch and crimp about ¼ inch of its end to trap the rubber band. Try to keep the rubber band to one side as you crimp the tube's end.

2. Pull the other end of the rubber band tight and crimp the outer tube's end as you did to the inner one. Do not stretch the rubber band too tightly—only enough to keep tension on the tubes when you let go.

3. Drill a 1⁄16-inch hole in each tube's crimped end and attach the standoff to attach the door and gear strut. Attach one end of the standoff to the gear door with a small attachment bracket; secure its other to the gear strut with a small machine screw. You'll have to drill and tap a small hole in the strut to attach the screw. And that's it! When the gear is in the down position, the gear door is supported by its hinge at the top and by the end of the standoff tube. When the gear retracts, the door is pulled shut, and the stand-off self-adjusts to the exact length needed to keep the door closed tightly. The rubber band keeps tension on the door so it will not blow open during flight.

Give this technique a try; it will make everyone think you spend an enormous length of time adjusting the door linkage. Go ahead; I won't tell anyone!

can all be ordered from Nick Ziroli Plans*. The Aeroplane Works offers a wooden kit that comes with plug-in tubes for the removable wing panels and the best-quality balsa and plywood for the parts. "User-friendly" definitely describes the kit and the finished model.

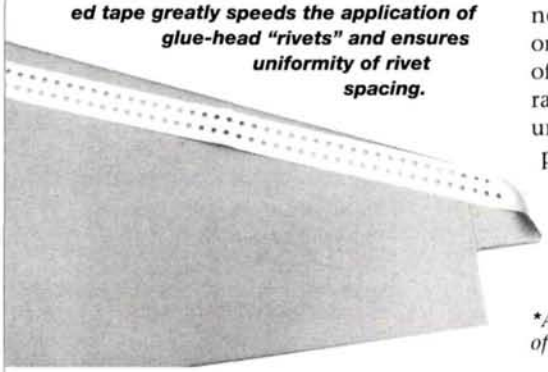


Bob Banka's Scale Model Research offers a wide selection of scale documentation. His latest catalog lists 7,800 full-color "Foto Paaks."

DOCUMENTATION CATALOG

I always look forward to the newest "Aircraft Documentation and Resource Guide" from Bob Banka of Scale Model Research*. I love Bob's 3-view drawings because they are from "Koku Fan" prints. This year, the 242-page volume includes several articles on scale modeling, many 3-views and a list of more than 7,800 full-color "Foto Paaks." Bob's guide is one of the best documentation sources for fighters, experimental and civilian aircraft, gliders, helicopters, gyrocopters, airships, guns, engines and even a few rockets. At $8, you will find it worth the investment.

Scale Skins' new "Rosie the Riveter" perforated tape greatly speeds the application of glue-head "rivets" and ensures uniformity of rivet spacing.



MORE ON RIVETS

Scale Skins* offers several products that give us new ways to detail our aircraft. First were large, easy-to-apply vinyl skins that had rivet and panel-line details printed on; next came clear detailing tape that had rivet lines, Dzus fastener and screw details; and now here's "Rosie the Riveter"—a perforated-masking-tape kit that's great for making make glue-head "rivets."

The kit includes glue (for the rivet heads) perforated tape (available with holes of several sizes) and a glue applicator. You simply press the tape down next to a panel line, apply the glue spots and let them dry. Remove the tape and you have a beautiful row of "rivets." Try it; you'll like it.

THE ART OF ILLUSION

Recently, I had an interesting conversation with my buddy Dick Bernier of Meister Scale* about my 84-inch Meister Bf-109. I asked him whether he thought I could convert it into a G-14AS version. We discussed the conversion process in detail, and then Dick told me what he thought about the whole scale modeling process:

"Scale modelers are illusionists; we try to create models that are interpretations of aircraft we like. When we build a model to a point at which we feel the illusion is complete, the model is complete also. If you were to put one of my stock, fun-scale Spitfires on a flightline, probably ninety percent of the spectators would be able to identify it. For some modelers, that is all they need to accomplish their scale illusion. If you were to take your Bf-109G-14AS to a fly-in, most people would know it as a Messerschmitt. A few would know whether it was an E, F, or G version, and fewer still would notice the different tail and canopy configurations. Finally, only you would be left knowing the subtle differences that set it apart from a stock G model. If you think you can fulfill your own G-14AS illusion, then the project is possible."

Dick's comments not only convinced me that I can indeed transform my model, but he also changed the way I look at other models.

Regardless of a model's level of "scaleness," we always seem to compare each one with our own set of standards. Instead of quietly looking for mistakes and inaccuracies, I now try to appreciate a model's uniqueness and all the effort the builder put into it. I try to appreciate the illusion.

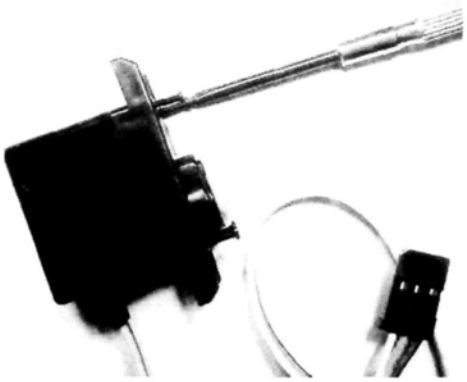
We should all be happy with our efforts if they measure up to our illusions of what they should be. Go ahead; create your own scale illusion!

**Addresses are listed alphabetically in the Index of Manufacturers on page 142.* ✈

by Don Edberg

Do-it-yourself servo repair

In my April '00 column, we discussed how servos work and how to interchange them between your models. Now it's time to look at what can go wrong with them. The most common problems occur in the moving parts: servo gears can lose teeth or become damaged; gear shafts can be bent or be torn loose from the case; the motor can develop a bad spot or fail completely; and the feedback pot can become dirty or worn out. Less common problems are amp failure or connector and wiring damage. Except for the failed amp, you can repair all of these problems with a few simple tools and basic soldering skills.



To inspect the gear train for damage, you need to remove the top of the servo case.

The exposed gears in a servo. Note the grease on the gears and the broken tooth between the lower two gears.

REPLACING A BROKEN SERVO GEAR

Let's discuss problems with the gear train. Sometimes, especially after a hard landing or a crash, a servo can move but will jam, make clicking sounds, or sound "tired," or will not move at all. This usually means that there is a problem with the gear train. Servo gear sets are available from manufacturers and well-stocked hobby shops (if you can't find them, you may have to return the servo to its manufacturer or a service shop).

Gears most often break when the control surface is forced from the outside. Aileron and flap servos are sometimes beaten up when the model lands, and they contact the ground. The cure is to put ailerons and flaps up just before touchdown, or keep the wings level! You can protect your servos with commercially available servo-savers that allow the servo arm to move if the load is too high, but these can cause flutter on a high-performance model. A better solution is to use servos that have metal gears that can usually withstand more abuse than plastic gears. I recommend metal-gear servos.

Damage to the mechanics can also include bent gear shafts (the metal pins on which the gears rotate) and damage to the top or bottom plastic case where the gear shafts are located.

To inspect parts of the gear train, you need to remove the top of the servo case. There are usually four screws that come up from the bottom or down from the top of the case. (Some microservo cases are just taped together.) You have to remove the servo arm as well. Very carefully, remove the top of the case by pushing downward on the top of the output gear that protrudes from the case. Be aware that several small pins and gears may fall out, so do this over a clean, closed area. You should see four or more plastic gears, often with some sort of grease applied.

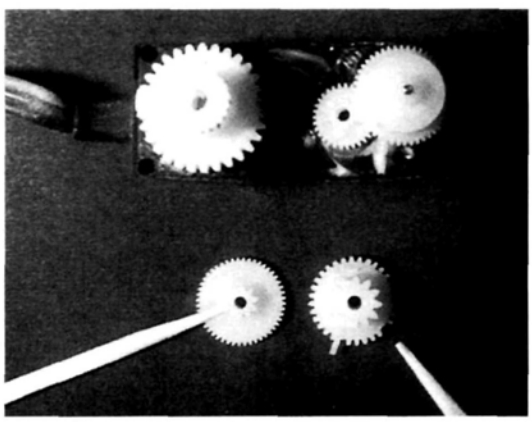
Examine the gears for missing or smashed teeth. They usually occur in either the output gear (the one that is attached to the servo arm) or the gear next to the output. When you find the damaged gear, you must remove it from the gear train. To do this, lift up the gear or remove the pin that goes through its center. You may need to take out other gears to get to the one that you need to replace. Be sure to note or sketch where each gear is positioned so you can put things back together.

If any of the gears are missing teeth, you'll have to find the missing teeth fragments. This can be tricky because of the grease, but be patient. I use a toothpick to probe around until I find the missing teeth. Be sure to find them all; if you don't, they can jam the new gears and continue to cause problems.

The output gear is attached to the shaft of the pot, sometimes by a press-fit. This means that to install a new output gear, you may need to open the pot assembly, press the wiper up to the output gear and then recenter the servo. It's easy to just install a new gear on servos that have indirect pot drive because the pot is driven by two pins that engage the output gear: simply lift out the old pin.

If you can't find broken gears or missing teeth, then the problem may be caused by a bent gear shaft, or the pins have been torn loose from the case's top or bottom. Remove each gear shaft with tweezers and inspect it carefully. You can often tell whether these shafts are bent by rolling them on a smooth surface or chucking them in a drill. If they are bent or broken, you'll have to obtain a replacement pin or case part from the manufacturer. Pins can be very hard to find.

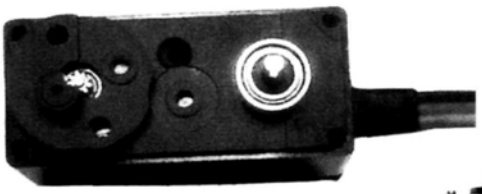
Don't use locking pliers or hemostats to grab the pins. One time, as I disassembled a German-made Becker servo, the pin shot out of the hemostat and "pinged" across my garage. I thought I was really in trouble, but I got a large, strong magnet and "waved" it across my garage floor. After finding a few loose fasteners, I heard that familiar "ping" and,

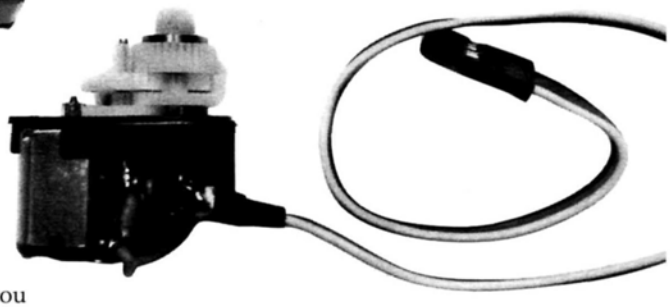


Some gears removed from a JR 221 servo. Note the missing teeth.

sure enough, the pin had jumped onto the magnet! I was very relieved!

Now you can replace the broken gears with new ones and place them back on the shafts in the servo case. Be careful to assemble the gears in the opposite order to which you disassembled them, referring to your notes or sketches. If you replace the output gear, be sure that it's properly seated downward on the pot and that you replace any ball bearings. You may have to gently pry existing bearings off the broken gears with a fine-blade screwdriver and place them on the new ones. Be sure they're seated properly.





Above: on this servo, the ball bearing is underneath the output gear. Right: the ball bearing on this servo is above the output gear and is seated in the bottom of the upper servo case.

After you've replaced the output gear, you can begin to add the other gears. Close up the servo-case top, being careful that all the pins fit into their respective holes. Do not force the case halves together; if the gear doesn't fit, take the top off and try again. When the parts pop together properly, you can power up the servo to check its operation (without replacing all the case screws) by holding the case halves together with your fingers (otherwise, parts may fly all over, and then you'll be in trouble!).

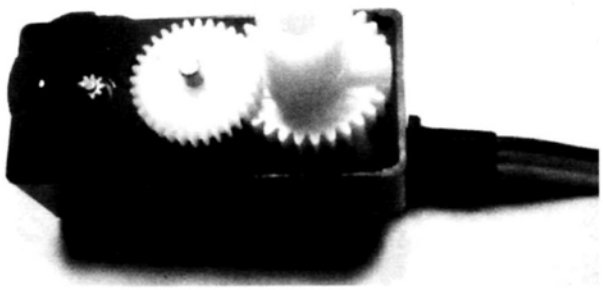
When you're satisfied that the servo is working properly, insert the case screws and gently tighten them. Do not overtighten the case screws: occasionally, this can cause the gears to become jammed, and the servo won't work properly. With a transmitter and receiver or servo exerciser, put the servo in its neutral position, then mark across the arm with a fine-tip, permanent marker. This will tell you the approximate neutral position when you later attach the servo arm or remove it for any reason.

REPLACING A TOP CASE AND ADDING BALL BEARINGS

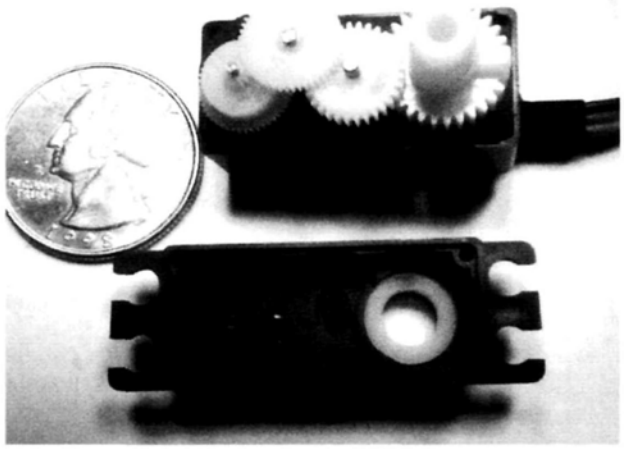
When they're new, inexpensive servos have a really close fit between the servo case and output gear shaft. This close fit, however, is "not so close" after flying for a while or after the plane has had a hard landing. To check for hole wear in the case, move the output arm near the arm screw from side to side without rotating the arm; compare the play with that of a new servo of the same type.

More expensive servos usually have plastic bushings or ball bearings around their output gears, so they can stand up to side loads much better and have much less tendency to develop play as they are used.

Upgrade kits are available to add ball bearings to certain servo models. To add the ball bearing, remove the case top, slip the ball bearing over the output gear's shaft, carefully drop the new case top into place, and gently retighten the screws. It usually takes less than five minutes to add a ball-bearing case top to a servo.



The broken gears are replaced with good ones, one at a time.



The servo's gears are all in place, and it's ready to be closed up. Note plastic output gear bushing in case top.

Ball-bearing upgrade kits for some popular types of servos are sold by EMS*, LDM Industries*, Tower Hobbies* and Boca Bearing*. If you have Futaba 148 or 3003 servos, you can use a standard-size bearing and the existing case. You can also buy bearings for Futaba servos from John Hawkins at 171 E. Chezzetocook Rd., Halifax, Nova Scotia, Canada B0J 1N0; parklane@netcom.ca; http://tor-pw1.netcom.ca/~parklane/index.htm.

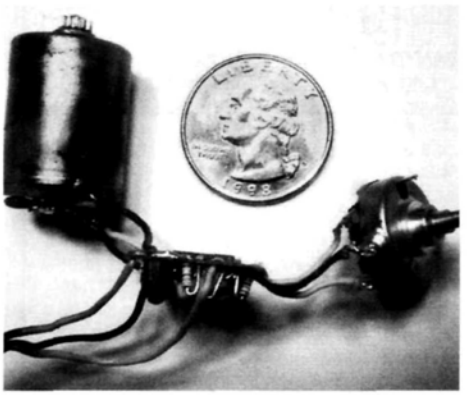
BUZZING AND NERVOUS SERVOS

Continuous servo buzzing is usually related to electrical noise, dirty feedback pots or control-surface linkages that are too stiff. Buzzing can also be caused by extension wires that aren't twisted or are too long. Whatever the reason, don't fly until the buzzing has been reduced, or your battery's life may be very short; a buzzing servo can drain a 500mAh battery in less than an hour! By the way, it is common for a servo to buzz for a second or so after it returns to center; but continuous buzzing is a problem.

Check buzzing servos by plugging them directly into the receiver. The problem might be related to the installation instead of to the servo, or it could be in the transmitter. To find out, plug the servo into another channel of the receiver. If it still buzzes, the problem is in the servo or the linkage. Try removing the linkage from the arm. If the servo buzzes only when it's plugged into one specific receiver channel, the pot in the transmitter is dirty and needs to be cleaned. This should be done by a professional repair person before you fly.

You may experience problems when you use servos out in the wings or tail on long extensions. One tested solution is to put a 100- to 470-picofarad (pF) capacitor between the signal and ground wires as close to the servo as possible. When you splice servo leads onto long extensions, install the capacitor at the splice and insulate it with heat-shrink tubing. The capacitor bypasses any high-frequency noise instead of sending it to the servo, where it can cause craziness. These capacitors can be found at RadioShack or any electronics store.

Occasionally, you may run into a problem with servo centering. This problem



One-piece servo pots are common these days. These pots may need to be replaced if servos become "nervous."

can sometimes be traced to a loose connection between the output gear and the feedback pot. (Remember, this connection is how the servo "knows" where to position itself; if the connection is bad, it won't be "sure.") Because the output gear is usually pressed onto a brass pin that's connected to the pot, the fix is simple: put a very small drop of CA on the pin before you push it back into the pot. Be very careful not to jam the servo with glue!

If you have a nervous servo—one that "hunts" or never seems to be able to find a neutral position—there may be a bad connection between the internal contacts of the pot (or a loose output gear as mentioned earlier). Most of today's servos have a one-piece pot/wiper assembly. These units can't easily be disassembled; instead, you have to buy a new pot from the manufacturer or let a repair person replace the pot.

Before you return the servo or try to take it apart, be sure that the problem is in the servo and not in the transmitter. Remember, the transmitter sticks also use pots with similar moving contacts! Try plugging into other receiver channels: if the problem disappears, it's probably in the transmitter as mentioned earlier.

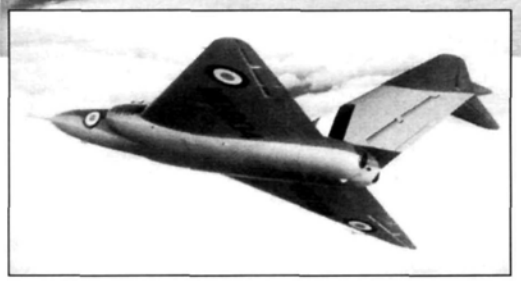
I've shown you just about everything you can do to fix or check servos; I hope you find this article useful and that you prolong the lives of many servos! Remember, if you want to write to me, send an SASE c/o *Model Airplane News*, 100 East Ridge, Ridgefield, CT 06877-4606 USA, or send email to man@airage.com. I get lots of mail, so please be patient! You can also check the questions and answers I've posted on my website: www.flash.net/~dynamic3/.

**Addresses are listed alphabetically in the Index of Manufacturers on page 142.* ✈

NAME THAT PLANE

Can you identify this aircraft?

Send your answer to *Model Airplane News*, **Name that Plane Contest** (state issue in which plane appeared), 100 East Ridge, Ridgefield, CT 06877-4606 USA.



The winner will be chosen four weeks following publication from correct answers received (delivered by U.S. mail) and will receive a free, one-year subscription to *Model Airplane News*. If already a subscriber, the winner will receive a free, one-year extension of his subscription.

Congratulations to James Zaprzalka of Chicago, IL, for correctly identifying our April 2000 mystery plane, the Gloster GA 5 Javelin. The jet was conceived as an all-weather fighter and as a first line of defense against atomic bombers. Test flights began on November 26, 1951, and this was the first in-flight shot taken of the GA 5. The 52-foot-span plane's delta wing enhanced stability and control at sonic speeds. The Javelin was powered by a pair of Siddeley Sapphire engines and carried a two-man crew.

MODEL AIRPLANE NEWS CLASSIFIEDS

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WANTED: ALL TOY METAL OUTBOARD MOTORS. Electric, wind-up and gas. Also wanted: .60-size spark ignition motors, thimble drone, etc., racecars. Call Richard, (231) 941-2111. [02/01]

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WANTED: Leica or Hasselblad camera outfit (camera, lenses, etc.). Write Virgil Frederiksen, P.O. Box 60781, Boulder City, NV 89006. [7/00]

USED ENGINES WANTED; pre-1970 preferred. T. Crouss, 100 Smyrna, West Springfield, MA 01089. [6/00]

EVENTS

"T.O.C. OF MARYLAND"—2000 FLY-IN COMPETITION. May 26, 27, 28. Come join us for one of the best combination fly-in/contests in the area. $$ prizes, raffles, hot grilled food, cold drinks. Competitors to fly known, unknown and freestyle programs, with emphasis on freestyle. Call Art Vail, (410) 247-4281 or email artvail@erols.com. [07/00]

1st ANNUAL CHARLOTTE SWAP MEET. Sponsored by Charlotte Aeromodelers at the historic Carolinas Aviation Museum, 4108 Airport Dr., Charlotte/ Douglas International Airport, Charlotte, NC 28208, Saturday, May 13, 2000. 9:00 a.m. to 1:00 p.m.; setup time 8:30 a.m. Admission, $4 (includes meet and tour of the facility). Tables, $10. For information and table reservations, contact Eric Hutchby, (704) 543-5152 or Scott Gantt, (704) 366-1451. Numerous full-scale Vietnam and Korean combat aircraft open cockpit displays and exhibits! Food and drink available (breakfast and lunch). [6/00]

INTERNATIONAL MODEL ENGINE COLLECTORS' EXPOSITION, Kalamazoo, Michigan, August 25 to 26, 2000. Model engines—model racecar displays—buying—selling—swapping—auction. Guest of honor: Dick McCoy. Test-running of many engines. Engine-collecting seminars. Open house at Aero Electric, Thursday afternoon, August 24; farewell banquet, Saturday evening, Kalamazoo Air Zoo. Featuring rides in the "Tin Goose," a 1929 Ford tri-motor. Advance table reservations and information packets: Bob Moore, 1103 Cherokee St., Kalamazoo, MI 49006; (616) 344-2055; fax (616) 345-0803; email mecaexpo@ prodigy.net. Sponsored by MECA—the Model Engine Collectors' Association—Woody Bartelt, chairman. [7/00]

Index of Manufacturers

Featured Manufacturers The following manufacturers' products are featured in this issue.

Aeroplane Works, The
2134 Gilbride Rd., Martinsville, NJ 08836; (908) 356-8557.

Airtronics
1185 Stanford Court, Anaheim, CA 92805; (714) 978-1895; fax (714) 978-1540; www.airtronics.net.

B&B Specialties
14234 Cleveland Rd., Granger, IN 46530; (219) 277-0499.

Bob Banka's Scale Model
Research, 3114 Yukon Ave., Costa Mesa, CA 92626; (714) 979-8058.

Boca Bearing Co.,
7040 W. Palmetto Park Rd., Ste. 2304 A1, Boca Raton, FL 33433; (561) 998-0004; fax (561) 998-0119; fax (800) 409-9191 (U.S. and Canada); bocabearings.com.

Century Jet Models,
11216 Bluegrass Pky., Louisville, KY 40299; (502) 266-9234; fax (502) 266-9244; www.centuryjet.com.

Cheveron Hobby Products
499 Milan Ave., Norwalk, OH 44857; (419) 668-5456; fax (419) 663-4349.

Coverite; distributed by Great Planes.

Du-Bro Products, P.O. Box 815, Wauconda, IL 60084; (800) 848-9411; fax (847) 526-1604; www.dubro.com.

Dynamic Balsa and Hobby Supply, Box 107, Leonore, IL 61332; (815) 856-2272; fax (815) 856-2270.

EMS, 22483 Mission Hills Ln., Yorba Linda, CA 92687; (714) 692-1393; fax (714) 692-1330.

Floquil, Rte. 30 N., Amsterdam, NY 12010.

Frank Tiano Enterprises, 15300 Estancia Ln., W. Palm Beach, FL 33414; (407) 795-6600.

Futaba Corp. of America; distributed by Great Planes Model Distributors.

Glennis Aircraft, 5528 Arboga Rd., Linda, CA 95901; (530) 742-3957; Glennis@2xtreme.net; www.Glennis.com.

Global Hobby Distributors, 18480 Bandilier Cir., Fountain Valley, CA 92728-8610; (714) 964-0827; fax (714) 962-6452.

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Great Planes Model
Distributors Co., P.O. Box 9021, Champaign, IL 61826-9021; (800) 682-8948; fax (217) 398-0008; www.greatplanes.com.

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JR; distributed by Horizon Hobby.

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Master Airscrew; distributed by Windsor Propeller Co.

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Nick Ziroli Plans, 29 Edgar Dr., Smithtown, NY 11787; (516) 467-4765; fax (516) 467-1752.

Norvel, 2244 E. Enterprise Pky., Twinsburg, OH 44087; (800) 665-9575; fax (330) 425-3935; www.norvel.com.

O.S.; distributed by Great Planes; www.osengines.com.

Parma/PSE, 13927 Progress Pky., North Royalton, OH 44133; (440) 237-8650; fax (440) 237-6333.

Robart Mfg., P.O. Box 1247, 625 N. 12th St., St. Charles, IL 60174; (630) 584-7616; fax (630) 584-3712; www.robart.com.

Scale Model Research; see Bob Banka's Scale Model Research.

Scale Skins Model Co., 210 Lorne Sq., Ste. 132, Birmingham, AL 35216; (205) 978-2964; (205) 824-5079.

Sig Mfg. Co. Inc., P.O. Box 520, Montezuma, IA 50171; (800) 247-5008; (515) 623-5154; fax (515) 623-3922; www.sigmfg.com.

Tower Hobbies, P.O. Box 9078, Champaign, IL 61826-9078; (800) 637-4989; fax (800) 637-7303; www.towerhobbies.com.

Windsor Propeller Co., 3219 Monier Cir., Rancho Cordova, CA 95742; (916) 631-8385; fax (916) 631-8386; www.masterairscrew.com.

Zap Glue, 9420 Santa Anita Ave., Rancho Cucamonga, CA 91730.

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GREAT PLANES
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1/4 Scale Aerobat

GILES G-202 ARF

GPMA1315 Specifications
Wingspan: 73 in (1855mm) **Wing Area:** 973 sq in (62.8 sq dm)
Weight: 12.5 lb (5670g) **Length:** 64.5 in (1640mm)
Wing Loading: 29.6 oz/sq ft (90.3 g/sq dm)
Requirements: 2-/4-stroke 1.2-2.0 cu in (19.5-33cc) glow or gasoline engine and a 4-6 channel radio w/6 servos (1 std, 5 w/65 oz.-in [4.7g/sq dm] of torque)

Designed for pilots who would never think of buying an ARF.

To the purists who can't see how any ARF could be as good as a hand-built kit, we extend an open invitation to take a good, hard look at the new Giles G-202 ARF. You won't see a typical ARF, but you will like what you see.

Unconventional by choice — Uncompromising in design.

One of the big things an ARF can offer is assembly speed — and the G-202 ARF won't disappoint you; as large as it is, it can be flight-ready in just 15-20 hours, using techniques you've already used with .40-sized ARFs. In addition, however, the G-202 features CAD-engineered, interlocking parts just like any GP kit; factory-assembly is just icing on top of the cake. The airframe is strong and light, as only wood parts can make it. What few non-wood parts there are are molded from tough fiberglass and factory-painted to match another G-202 asset: the factory-applied MonoKote® finish.

Covered in MonoKote — Equipped for performance excellence.

Known for its amazing adhesion and rich, glowing colors, MonoKote has been the "gold standard" of iron-on film coverings for over 30 years. Only a handful of ARF airplanes in the world can boast of a factory-applied MonoKote finish... and the G-202 is one of them.

Even fewer can match the G-202 when it comes to "the Big One": *performance.* Combine its wood airframe with any of the suggested engines, and the G-202's lightness and lift inspire the same control confidence you feel with much smaller planes. Add in aft-mounted servos and unconventional features — such as double-beveled elevator and rudder surfaces — and its incredible performance envelope is easily understandable. Each aileron is moved by its own wing-mounted servo. Both elevator servos (one for each side) are tail-mounted, just like the rudder servo. And, since the distances between servos and control surfaces are so short, response speed and strength rocket past the needs of knife-edge flight and on into new realms of 3D wonder. A symmetrical airfoiled stab that tames the tail also reduces tip stall tendencies, giving the G-202 the smooth, predictable feel of the best aerobats.

If you're a purist of uncompromising standards, come see the ARF that's uncompromising in design: the Great Planes Giles G-202 ARF. For the location of the hobby store nearest you, please call 1-800-682-8948 and mention code number 0231P.

"The Giles G-202 ARF quite literally adds new dimensions to the swift, sure response you've enjoyed with .40-size aerobats. Larger, more impressive, and more realistic to fly, it's the easiest way I know to step up into the fun and excitement of giant-scale modeling."

Don Anderson

Don Anderson
President and Founder
Great Planes Manufacturing

Expertly Covered with TOP FLITE MONOKOTE

Make the jump from .40-size displacements to giant-scale star with ease. Major sections are factory-assembled, covered in MonoKote and equipped with Great Planes' own quality hardware. All fiberglass components feature MonoKote-matching paint.

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Advertisers

Virtual Pilot

I often wondered what the view would be like from the cockpit of my model. I thought a small camcorder mounted onto my plane would satisfy my curiosity, but after I reviewed the video at home, I became hooked. Now I wanted the capability of real-time control while experiencing the view from my model.

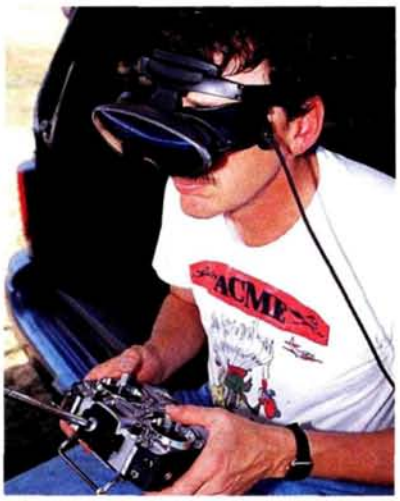
I started with one of those small video monitors designed for a baby's room. This fulfilled the purpose of broadcasting a picture back to a monitor, but the black-and-white monitor lacked the clarity and size I wanted, and the wide-angle lens allowed no depth perception. With that brief education under my belt, I compared the cost, quality and weight of other commercially available systems. Onboard telemetry was on my wish list, too, but first I needed a working setup.

While attending a trade show, I found an adequate solution that consisted of a complete camera, transmitter and receiver unit. The camera's design is essentially the type you may have seen used by security guards; the operator can remotely manipulate the zoom and focus. This provides the color view I want and the correct depth of field. The airborne components operate off a 10-cell Ni-Cd pack. The signal is broadcast to the battery-powered receiver monitor. Although the camera was a bit pricey at the time, I understand the costs have dropped significantly.

I selected the 3-channel Big Nifty for my airborne platform. The 96-inch flat-bottom-wing cabin plane is a double-size version of the original Florio Flyer Nifty 50 trainer. I was so impressed with the plane's flight qualities using glow fuel, that it was my first large-scale electric conversion. The big bird is docile and predictable— just the kind of stability required for this project .

The initial tests revealed that the plane's large electric motor scrambled the video transmission. I eliminated the interference by moving the downlink antenna approximately 18 inches away from the plane's motor. I began with the camera pointed straight ahead. This offered a great view, but a slight downward lens angle is necessary for a ground reference. The next few flights involved zoom adjustments for a proper 1:1 look from the plane. Without this, you can never tell when to flare or turn at the appropriate time. Overall, I was encouraged; however, the broadcast range was somewhat limited. The picture was razor sharp when the signal was strong. To allow me to enjoy views from maximum altitude, the plane's antenna pointed straight down; this way, it had maximum range when overhead. The problem is that when you are distant and turning (such as base turning onto final approach), the antenna points away from the ground receiver! I wanted to improve the reception quality before declaring this project a success.

The Big Nifty is off on another virtually piloted flight. We now share our airplane's unique view of the world.



The Sony virtual glasses offer a unique "pilot's-eye-view" from the airplane. They do take some getting used to.

Any electronic hardware with removable screws on their cases is meant to be opened. I easily identified the manufacturers of the internal circuitry and contacted them about how I could improve the system for my application. I upgraded the receiver components and was able to improve the downlink reception to a satisfactory range. The ground receiver's antenna does need to be pointed line-of-sight toward the airplane, and that requires a helper. This actually works out well because the person who aims the receiver antenna also acts as a safeguard for the plane's heading, approach and traffic clearance.

My final goal was altitude telemetry. Instead of feeding sensor data into the video signal, I simply placed a Casio altimeter watch in front of the camera. Now the plane's height and flight duration were right there! I added to the system a pair of Sony virtual reality glasses that operate simultaneously with the TV. At first, it takes only a few banked turns before you fall over from disorientation and clamber for a place to sit, but the glasses really do complete the package.

We regularly complete entire flights—takeoff to landing—using solely the monitor or glasses. Imagine the applications for this incredible capability. A model can capture aerial photography in locations that would be impossible for a full-size plane. Why not use a servo to tilt the camera down? With this added flight perspective, we're sure to ace the bomb-drop event at this year's club fun-fly!

PHOTOS BY WALTER SIDAS

Above: here's a downlink view of the airplane approaching the bomb-drop circle. The altimeter indicates a 540-foot altitude. Right: the author makes the final preflight electrical connections, while Dave Baron handles the flight controls.